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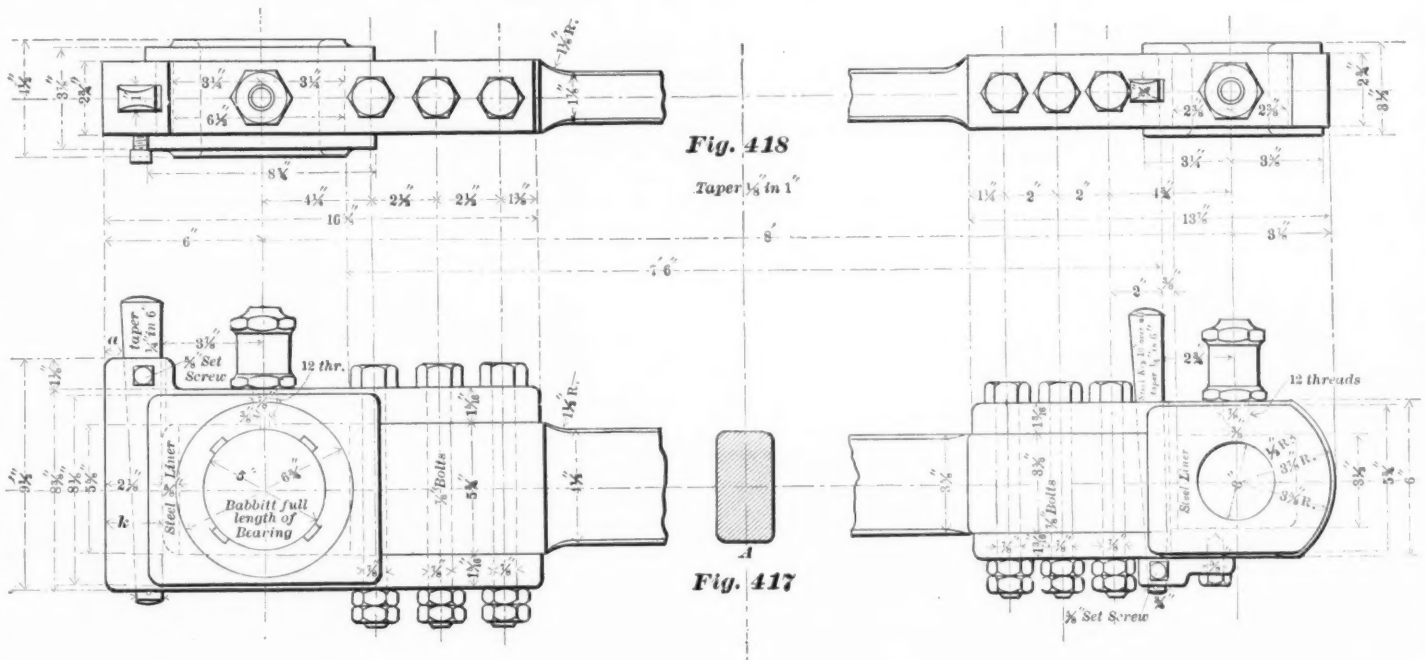
Modern Locomotive Construction.

BY J. G. A. MEYER.

SEVENTIETH PAPER.

Figs. 417, 418 represent a main rod, and Figs. 419, 420 represent a side rod for a four-wheeled connected engine, such as is shown in Fig. 1; cylinders 18x24 inches. The design of the main rod is similar to that shown in Figs. 413, 414 (last paper), with the exception that the keys (Fig. 417) are plain keys and held in position by set screws.

The design of the side rod, Figs. 419, 420, differs greatly from that shown in Fig. 415. As will be noticed, straps are not used for the side rod represented in Fig. 419. These rods are forged in one piece, the ends bored out, and brass bushings pressed in. The form of the rod here represented also differs greatly from the form of the ordinary side rod. The cross-section of an ordinary side rod is rectangular, similar to that shown at *A*, Fig. 417, whereas the cross-section of the rod, Fig. 419, has the appearance of an I. There is another distinct type of side rods which we shall illustrate in our next paper, thus giving three distinct types of side rods which at present are in use. The advantages claimed by their advocates will be considered later.



MODERN LOCOMOTIVE CONSTRUCTION.

Main rod straps.—Figs. 421 and 422 (page 2), represent a main rod strap with key. This form of strap is very often used; in fact, in the majority of locomotives we find the straps on all the rods, excepting the straps on the front end of the main rod, made to a rectangular form, as shown in our illustration. As to the strap on the front end of the main rod, we are often compelled to round off its end as shown in Fig. 417, so as to give the strap sufficient clearance in the crosshead while the rod oscillates on the crosshead pin.

The length *c d* of the space, or that part of the opening of the strap marked *A*, should be sufficiently great to admit the brasses and the liner *l* as shown. The length *d e* of that part of the opening marked *B*, is determined by the number of bolts through the strap and the width of the key, as will be presently explained.

We occasionally meet with straps whose openings are of equal width throughout; that is to say, the distance between *t* and t_2 is equal to that between *s* and s_2. But we believe it is safe to say that, in a large majority of straps, the thickness of the metal at *f* is greater than the thickness at *g*; and thus making the width $s\,s_2$ less than the width of the opening at $t\,t_2$. The straps are planed so as to make the surface *t* parallel to t_2; and *s* parallel to s_2, leaving a projection in line with *d*. Since the portion of the strap marked *g* is weakened by the bolt holes *i i*, we may be led to the conclusion that this strap is badly proportioned, and such a conclusion will be correct, if only the strength of the strap is considered. Indeed, if we are requested to design a strap which shall be simply of equal strength throughout, we would make the thickness at *g* greater than that at *f*, so as to allow for the loss of strength caused by the holes *i i*. But in designing straps for locomotive rods, other considerations must be taken into account. One of the aims of a locomotive designer is to design an engine which can be kept on the road in good working order at a minimum cost, and also reduce as much as possible the time during which the engine is kept out of service for the necessary repairs; and these are the conditions kept in view, or which should be kept in view, when a strap for a locomotive rod is to be designed. Consequently, the thickness of the straps at *f* is greater than at *g*, for the following reason: In practice it is found that the inner surfaces $s_1\,s_2$ will wear unevenly, and the brasses become loose long before the strap needs any other repairs. Now this extra thickness of metal at *f* will allow the surfaces $s_1\,s_2$ to be trued up or replaned without touching the inner surfaces *t*, t_2. New brasses can then be fitted in the space *A* and the rod restored to good working order in a comparatively short time, and at a minimum cost. On the other hand, if there had not been any extra thickness of metal at *f*, then as soon as the inner surfaces of the strap become worn, they will have to be replaned from end to end, making the opening of the strap, that is, the width from *t* to t_2 too wide for the end of the rod; and therefore, in this case, the strap will have to be heated and upset at *k*, so as to close the opening to fit the end of the rod. In doing so the holes *i*, *i* will be thrown out of line, and otherwise cause considerable expense and an extra expenditure of time (which always means delay in getting the engine into service) before the rod can be brought into working order.

The usual practice is to make the thickness of the strap at *f*, ⅛ of an inch greater than at *g*; occasionally we find the difference of these thicknesses to be only 1-16 of an inch. When there is no key through the end *k* of the strap, the thickness at *k* is generally ¼ of an inch greater than at *g* for small engines; and from ⅜ to ½ inch greater at *k* than at *g* for large engines. When there is a key through the end *k* of the strap, as shown in Fig. 417, the thickness of the metal at *k* is determined by the width of the key. In small engines, say engines with cylinders 14 inches in diameter, the thickness at *k* is generally such as to leave ½ inch metal at *a* (Fig. 417), that is, ½ inch metal at the outside of the wide end of the key. As the diameters of the cylinders are increased, the amount of metal at *a* is also increased at a rate which will give about 1 inch metal at *a* for engines with cylinders 20 inches in diameter. These dimensions here given are about the average of those which we have seen.

The width of the strap depends upon the length of the crank-pin journal, or the length of the crosshead pin. By deducting from the lengths of these journals the thickness of the brass flanges, the width of the strap is at

once determined. Hence in designing straps for locomotive main or side rods, about the only calculations which we have to make are those for finding the correct diameters for and the number of bolts through the straps, and the correct thickness of the strap at *g*, Fig. 421.

The Oscillations of High Chimneys.

In the *Mémoires de la Société des Ingenieurs Civils* some particulars are given of the oscillations of a chimney stack near Marseilles, 35 meters (115 feet) high, with an exterior diameter at the top of 1.22 meter (4 feet). During a severe storm it was determined, by observing the shadow of the chimney, that its greatest oscillation was half a meter (nearly 1 foot 8 inches). It was further observed that a chimney set in motion by a gust of wind oscillates from four to five times backwards and forwards until it is at rest again. M. E. Burg asserts that, should this momentum during the oscillations of a chimney repeat itself in such a manner that its direction coincides with that of the oscillation, the overthrow of the chimney may be expected. This is the explanation given for the destruction of many a chimney constructed in accordance with sound principles of stability. The *Oesterreichische Zeitschrift für Berg-und Hüttenwesen* adds to this statement the qualification, that in the case of a chimney near Vienna, 50 meters (164 feet) high, and constructed of concentric (hollow) rings, with an inner diameter at the top of 2 meters (6½ feet), which is exposed to considerable gusts of wind, the oscillations were most carefully and repeatedly measured with a theodolite, when the observations showed an extreme oscillation of only 16 centimeters (6½ inches) during severe storms.

Trade Prospects.

Coupled with warm weather there is just now the usual distracting element of an approaching presidential election to disturb trade, and it cannot be denied that these combined influences are having some effect. They always have an effect, and it is no more marked—hardly as much—this year as in most preceding years in which a presidential election has occurred. It is an excellent thing to keep cool, physically, in warm weather, and it is equally as excellent a thing to keep cool, metaphorically, in the years of presidential elections.

In spite of the politicians, a part of whose trade it is to disturb business for political ends, trade of all kinds is very good for the time of year. Men must eat and wear clothes, and they must buy machinery and manufactured articles, and they understand, a little better every year, the infinite humbug of politics.

At this writing it is certain that the differences between the manufacturers and the Amalgamated Association are settled. All the firms have withdrawn their intention to reduce wages, and the prices for work proposed by the Association will prevail for one year to come. This is not victory for the men any more than it is victory for the manufacturers. The sensible manner in which Western manufacturers settle the question of wages with the Amalgamated Association—settle it without the usual hard feeling and bad blood—is always to be commended.

The fact that the manufacturers have concluded that they could work through without reduction of wages is a hopeful sign. These manufacturers are shrewd in their forecast of business prospects. It is plainly evident that they see at least fair prospects ahead. Their opinion, as shown in their conclusions in relation to the wage question, is valuable, and may be depended upon.

Iron manufacture is one of the great industries of this country; if that is on a solid basis there is little to fear.

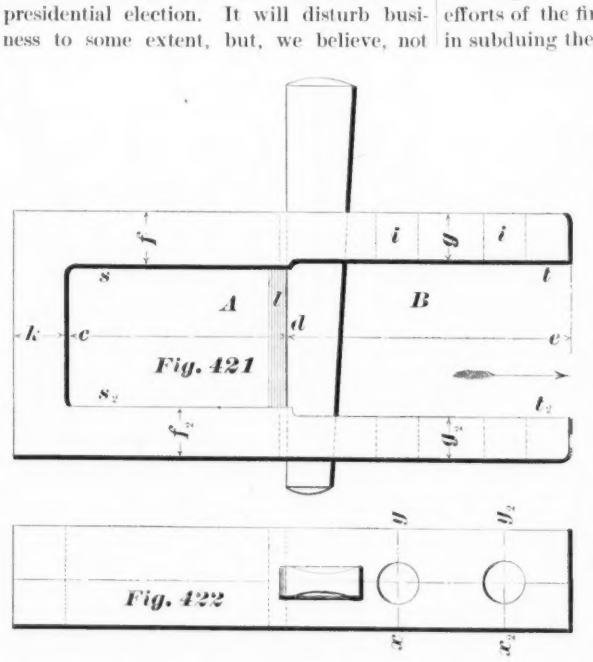
Notwithstanding the disturbing influences of a presidential contest, it will be seen that new enterprises are being projected about as usual, and the building of new works, and the enlargement of existing works, goes on the same as ever. Seed time and harvest in manufacture are not things of the past.

There is all the railroad building that there ought to be going on. Railroad building has frequently, in the past, been quite ahead of the requirements. If this is changed to some extent this year it will be a good thing. There is no present evidence that railroad construction this year will not be all that it should be for the best interests of the country.

The crop prospects continue good. In some instances there is an evident intention to deny this, for speculative purposes. In special localities there is, as there always will be, partial failure. But, taken as a whole, there is every evidence to believe that the crops will be abundant. This always has an important influence on manufacture; without agriculture, manufacturing and railroad interests in this country would be low indeed.

There are under way important mechanical and engineering projects, that will call for large amounts of material and a good deal of labor. And the Government is likely to be in the market for a large supply of both. Those who are faint-hearted are so without apparent reason. Labor is fairly remunerated, which always means that times are to be good. Such signs of depression as may now appear are temporary in their character, and are no index of future prospects.

From all we can gather—East and West, North and South—business prospects are bright. Just as we have every four years, so this year we must have the disturbance of a presidential election. It will disturb business to some extent, but, we believe, not seriously. The day in which the political shouters and marplots can influence business matters is happily passing away, and common sense and business forecast is coming to the front. It is a fortunate thing that this is so.



Modern Locomotive Construction.—See Page 1.

A New Flameless Explosive.

Our English contemporary *Iron*, gives an account of some tests of another new flameless explosive, for use in coal mines, called "Securite."

It is the invention of Herr Schoenweg, and has been used in Germany for about two years past. "It is composed of a nitrated hydro-carbon in combination with certain oxidizing agents," which is rendered flameless by the addition of a certain proportion of an organic salt.

It emits a spark in exploding, but this spark is harmless, not possessing sufficient energy to explode inflammable gases or coal dust. By the action of the organic salt the spark is almost instantly extinguished. In the tests mentioned, the flameless "securite" was exploded in vessels containing the most highly explosive mixture of gas and air, and, in some cases, this combined with coal dust, but, while gunpowder invariably causes their explosion, the flameless "securite" did not ignite the gas or the coal dust, and it was demonstrated to be safe, even under more severe tests and conditions than are ever present in mining operations.

The tests were made for the Flameless Explosives Company, of 35 New Broad street, London, and one of the gentlemen making the tests gives it as his opinion, that "flameless 'securite' is a most valuable blasting agent, and one which, if properly used, will give an assurance of practically absolute safety in mining work, so far as the communication of flame to the surrounding atmosphere is concerned."

There is no reason to doubt that Russian petroleum is crowding the products of the United States in all European countries. There is no reason why this should be so, except that the product of petroleum in this country is in the grip of a giant monopoly that looks to its own gains, every time, instead of to the production of something that shall enrich the whole country. Russian petroleum is in every way inferior to the American product. And the American article is more easily come at and handled. But individual operators are debarred from producing petroleum, and the result is that exportation must cease, because more money can be made by selling less at a higher price.

There is an old saw about "setting the river on fire," and it appears that a Chicago small boy has demonstrated the possibility of doing it. A lighted match thrown by the aforesaid small boy into the Chicago river near the stock yards, communicated its fire to the grease covering the water, and the efforts of the fire department only succeeded in subduing the flames after several thousand dollars damage to the docks.

We take the following from an exchange that is in the habit of crediting its borrowed matter to *Ex.* This prevents us from giving customary credit:

For making a rust joint that will bear heat, cold and rough usage, the following formula has been highly recommended: Ten parts iron filings, three parts chloride of lime, and enough water to make into paste. Put the mixture in between the pieces to be joined, and bolt them together, leaving until dry. After twelve hours the cement has been known to break off the solid iron.

It is reported that a company has been formed in Berlin to manufacture electrical watches. Two small cells and a small electric motor take the place of the ordinary movement.

A Historical Watch.

Mr. J. Morch, a Brooklyn jeweler, is the possessor of a very valuable and historically interesting watch. It was made to order for a lady belonging to the house of Orleans, and gradually found its way into the hands of one of the younger members of the family, who was, in 1848, forced to flee from France together with Louis Philippe. In the same year the watch was pawned in New York by a foreigner, who was in financial straits. It was then sold, and came into possession of the Morch family. The watch is said to be a wonderful product of human ingenuity. It has 603 parts, and a musical work is connected with it, which plays several pieces. It is a repeating watch, indicates the full and quarter hours, and its rate is said to be in no way inferior to our best chronometers. The dial is of the finest enamel, and represents the Tuilleries and their surroundings. In the corners, underneath foliage, are seated two female figures, one of which plays upon a lyre, the other upon a guitar, while a rope dancer gesticulates upon a gold wire stretched above the dial. The watch was once about to be presented to President Lincoln, but for some reason or other the conveyance was never effected.—*The Keystone.*

Literary Notes.

STEAM BOILERS. A Practical Treatise on Boiler Construction and Examination, for the use of Boiler Makers, Boiler Users and Inspectors; and Embracing in plain figures all the calculations necessary in designing and classifying Steam Boilers. By Joshua Rose, M. E. Illustrated by 73 engravings. Philadelphia: Henry Carey Baird & Co., 810 Walnut st., Philadelphia, Pa. Price, postpaid, $2.50.

Mr. Rose is well known as an author of several popular works on mechanical subjects, and we see no reason to doubt that the present work will prove as popular as those that have preceded it. In his preface he says: "The object of this book is to enable any engineer having an ordinary knowledge of decimal fractions to thoroughly understand the proper construction and determine the strength of a modern steam boiler."

As might be inferred from the above quotation, the author has simplified all calculations so that the practical steam engineer will find no difficulty in applying them to his practice. This will be appreciated, as well as the effort to make the language clear and comprehensive.

We should think the book well suited to its purpose. It is quite fully illustrated.

The Cincinnati *Artizan* comes to us this month with the Cincinnati left out of its title, and in a new dress, and with new proprietors. Mr. A. A. Brown makes his bow to the public as editor, and in the first number shows his good judgment by copying an article of about a column from the American Machinist, and his——forgetfulness, or inexperience, by omitting to give any credit for it.

A new way of annealing small pieces of steel is given by a writer in the *English Mechanic*. Heat the piece as slowly as possible, and when at a low red heat, put it between two pieces of dry boards and screw them up tight in a vise. The steel burns its way into the boards, and on coming together around it they form a practically air-tight charcoal bed, which, when it cools off, the steel is apt to be found thoroughly annealed.

An Evidence of Coming Sense.

There is superabundant evidence that the Brotherhood of Locomotive Engineers almost to a man repudiates the acts of the few members in its ranks who have resorted to violent attacks upon the railroad company by which the strike of the Brotherhood was defeated. Truly, if an organization like the Brotherhood, performing such duties as belong to its members, could be justly accused of concocting and carrying out dynamite conspiracies, there would be widespread alarm in the community, and this would be followed by effective means of public protection against the danger which created it. But it has been made certain that the Brotherhood itself would be foremost in adopting steps to punish any member false to his duty and his pledges.—*The Sun.*

The length of pipe laid in Paris for the distribution of power by compressed air already exceeds 30 miles. The compressing engines are of 3,000 horse-power, and about 3,000,000 cubic feet of air are compressed daily to a pressure of 80 lbs. per square inch, at an expenditure of 50 tons of coal.

Considering the nearness of the vacation season, the following may be interesting. We do not know its source:

"Three-fourths of the moss on trees grows on the north side; the heaviest boughs on spruce trees are always on the south side; and thirdly, the topmost twig of every uninjured hemlock tips to the east."

In Professor Sweet's article, "A Mid-Summer Sermon," in our issue of July 28, near the top of the third column, it reads: "Make it smaller *when* it don't break." This is a typographical error. It should be: "Make it smaller *where* it don't break."

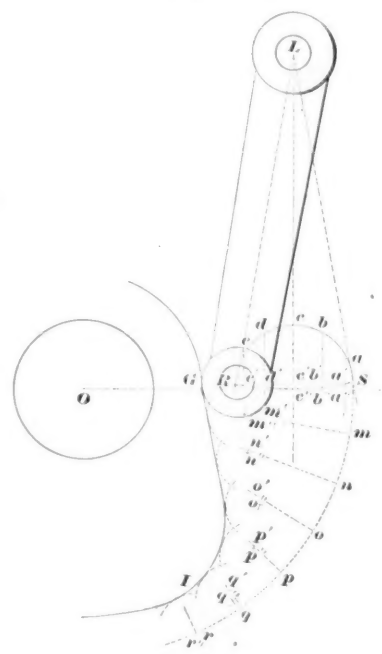
British and American Production of Iron and Steel.

The full figures for 1887, which are now before us, enable a comparison to be made, which is interesting and instructive, if it is not altogether flattering to our self-love as a manufacturing nation. In that year the production of iron and steel in the United States reached a figure which placed all previous years completely in the shade, and reasserted the claim which that country had established in 1886 to pre-eminence in the output of steel. As we shall see presently, Great Britain increased its production in somewhat larger ratio, and reduced slightly the lead of the United States, but the gain was of very small proportions. Last year was as much entitled to be called a year of boom in the iron and steel trade of the United States as 1880, although only so far as production was concerned; the capacity of the works having been enlarged to such an enormous degree as to prevent the upward rush of prices which took place in the earlier year. In fact, prices fell steadily during the course of 1887, as the conviction gained such ground that the activity then being experienced could not long be maintained at the same pitch. The cause of this activity lay mainly in what it is scarcely too strong a term to call the abnormal development which took place in the railway system of the United States in the years 1886–87. During these two years 21,000 miles were added to the already large total laid down in the States. That is to say, that a mileage equal to what we have attained in this country after more than fifty years of railway building was constructed in America in twenty-four months, leaving out of the reckoning, of course, duplications of tracks, sidings, etc. Such an achievement as this implies a great demand directly on the capacity of the iron and steel producers, principally for steel rails, but also largely for fishplates, bolts and nuts, spikes and other permanent way material. It implies, however, a heavy indirect demand through bridge builders, locomotive builders, carriage and wagon works, and other secondary channels. In addition to all this, we are informed that, owing to the general activity of business throughout the States, existing railways found their rolling stock insufficient to meet their requirements, and had to add to the pressure on the carriage and wagon builders; and they also took advantage of the prosperous times in many cases to relay permanent way, to duplicate lines, and to substitute iron bridges for the old wooden structures. When all this is going on over a vast country like America, and is compressed more or less into the short space of two years, it means excessive activity in the trades affected.

In 1887 the United States still further decreased the gap between its production of pig-iron and that of Great Britain. Ten years previously the production of this country amounted to 6,608,664 tons, and that of America to 2,066,549 tons—in round figures, four and a half million tons less. Last year Great Britain turned out 7,441,927 tons, and the United States 6,417,148 tons, or little more than a million tons less. In other words, while this country increased its production only 12½ per cent., the United States increased theirs upwards of 200 per cent. In point of consumption, the States tread more closely on the heels of this country, for while Great Britain consumed or exported 7,317,067 tons, America used up 6,808,386 tons; but, properly to appreciate these figures, it must be borne in mind that in respect of the United Kingdom the quantity sent out of the country is included, while in the case of the United States the whole may be considered to have gone into consumption within their own borders, and, moreover, it includes some 400,000 tons of pig-iron exported from this country, but really, in strict terms, *consumed* in America. It is, however, when we turn to figures relating to the stocks held in the two countries at the end of 1887 that we see how much more favorably situated are manufacturers on the other side than are those on this. It will be remembered that, in spite of the increased quantity of pig-iron which went into consumption in or was exported from Great Britain in 1887, the quantity held in stock grew during that year by 124,860 tons. On the other side of the Atlantic stocks increased also, but only to the extent of 76,284 tons. But it is in the actual amount which the trade has to carry that we stand at such great disadvantage compared with America. On December 31, 1887, the total of the stocks in this country amounted to 2,616,366 tons, against only 301,913 tons in the United States. In the former case they were equivalent to 18½ weeks' consumption at the rate of 1887, and in the latter case to less than 2½ weeks'. It should be explained that the stocks given for the United States do not include such quantity as may have been sold, but not removed from works, or parcels in the hands of speculators, brokers, or creditors; neither do they embrace foreign pig-iron in bond. In the last mentioned case the quantity is said to be small, but in the others it may mean a considerable addition to the figures given. Apart from this, there are, no doubt, some people who would say that the stocks held in the United States are not sufficient to give stability to the market, and we are not prepared to say they are not right; but, on the other hand, we think no one will aver that the stocks in this country are necessary to a healthy condition of the trade. Notwithstanding the large production of steel in the United States, the make of spiegeleisen remains very small, owing to the scarcity of the proper ores. Last year it amounted to 42,500 tons, compared with 233,190 tons in this country.

If Great Britain is still able to assert its supremacy in the production of pig-iron, it must admit that in the make of Bessemer steel it is fairly outstripped by the United States. That this is so will not be considered surprising, when it is remembered that the facts to which we drew attention at the outset would mainly entail a pressure upon Bessemer producing works. The total quantity of Bessemer ignots made last year in America was 2,936,033 tons, as compared with a production in this country of 2,064,403 tons. Naturally, a very large proportion of this class of steel was turned into rails. In the case of the United States it amounted to 2,044,819 tons, to which must be added 57,085 tons made in iron rolling mills from purchased blooms. Including 17,145, tons made from open-hearth steel, and 20,591 tons of iron rails, we have a total production of rails of 2,139,640 tons. So far as this country is concerned, the make of rails may be taken to be commensurate with the make of Bessemer steel rails, and that amounted to 1,021,847 tons in 1887, or less than half the make in the United States.

Deducting the steel that was turned into rails from the total productions, we have left 891,214 tons in the case of the United States, and 1,042,556 tons in the case of Great Britain, which were available for other purposes. From these figures alone it is evident that last year's great production in America was essentially due to railway requirements, and if we take into account as well the production of open-hearth steel, this is put beyond controversy. Of the last mentioned description of steel, 322,069 tons were made in the United States, as compared with 981,104, tons in this country. From the American production we must deduct 17,145 tons rolled into rails, leaving 304,924 tons available for other purposes, which, added to the surplus of the Bessemer steel, gives 1,196,138 tons as the quantity of the two descriptions of steel available for other purposes than rail making. In Great Britain we may take it that no open-hearth steel to speak of was manufactured into rails, so that we have in the case of this country an aggregate of 2,023,660 tons of steel which would be made into miscellaneous forms. We may therefore fairly derive some satisfaction from the thought that the steel trade of Great Britain is established on a wider basis, and consequently a firmer one, than is that of the United States. There is one point, however, to which attention should be drawn, and that is the very much larger average output per Bessemer furnace which the Americans attain than manufacturers in this country have arrived at. Here the average number of converters at work last year was 86⅛, and the production 23,778 tons per converter. In America eleven new Bessemer works were completed in 1887, and the number of converters at the close of the year was eighty-nine. Assuming that all these were at work during the whole of the year, we obtain an average production of almost 33,000 tons; but, of course, the newly erected converters would only be working for a longer or shorter portion of the twelve months, and therefore the average production per furnace must have been considerably more.—*Iron.*



Laying Out Cam Curves.

By S. Burdsall.

In designing the curves of cams I have found the following method to work well in practice:

Let O be the center of a cam shaft, $L\ R$ a lever pivoted at L and oscillating through the angle $R\ L\ S$. With L as center and $L\ R$=length of lever as a radius, draw the arc $R\ S$, and through O draw $O\ c''$ tangent to this arc. Draw $L\ c''$ perpendicular to $O\ c''$; $L\ c''$ will bisect the angle of oscillation of lever. Lay off $c''\ R$=$c''\ S$, making $R\ L\ S$= angle of oscillation. Through R draw the line $R\ S$, radiating from O, bisect this line in c', and with c' as center draw the semi-circle $R\ c\ S$. Divide this semi-circle into any number of equal parts Sa, ab, bc, etc., and through the points a, b, c, etc., draw the perpendiculars aa', bb', cc', etc. On the line $R\ S$, with O as center, and with any radius, as $O\ S$, draw the arc $S\ r$. Lay off $S\ r$, making the angle $S\ O\ r$ equal that part of the revolution in which it is required to move R to S. Divide the arc $S\ r$ into the same number of equal parts that the semi-circle $S\ c\ R$ is divided into. Through the points m, n, o, etc., thus found, draw the radial lines $m\ m'$, $n\ n'$, $o\ o'$, etc., and from O as center lay off $O\ m'$=$O\ c'$, $O\ n'$=$O\ d'$, $O\ o'$=$O\ e'$, etc.; through these points draw the short arcs $n'\ n''$, $o'\ o''$, and make $o'\ o''$=$c'\ c''$, $p'\ p''$=$b'\ b''$, etc. With the points $m''\ n''\ o''$, etc., as centers, and with radius equal to the radius of the roller, draw curves, and tangent to these curves draw the curve $G\ I$, which will be the required cam curve. It will be seen that this curve will give the same motion to the roller as would a crank with stroke $R\ S$ made in time represented by angle $S\ o\ r$.

New York harbor has been shamefully filled up in the past by the dumping of refuse. Now, by provision of Congress, an officer of the United States Navy becomes supervisor of the harbor, and he will grant permits for the dumping of refuse at such points as he may designate.

Some time since we alluded to experiments in the direction of glass-blowing by machinery. This is said to be an accomplished fact in Europe. No one need be sorry if the day of mouth-blowing is done. That it is so ought to benefit everyone, and save the lungs of the glass-blower.

Hiram Sibley.

By the recent death of Mr. Hiram Sibley, at Rochester, N. Y., one more of the men intimately associated with the early history of the development of the telegraph has passed away.

Early in life Mr. Sibley carried on a machine shop, finally disposing of it to go into banking. He afterwards became associated with Ezra Cornell in the development of the telegraph, and it was due almost entirely to his enterprise and faith in it that the first trans-continental line was erected.

He was one of the organizers of the Western Union Company, and was for some years its president, finally retiring from active participation in the telegraph business, and establishing a large seed and nursery business in Rochester, in addition to which, he was interested in and took an active part in the management of railroads, banks, salt mines, and other enterprises on a large scale.

His liberality was manifested in various directions, perhaps the most notable being in the founding of the Sibley College of Mechanic Arts at the university founded by his old friend and business associate, Ezra Cornell. This college he built and endowed, thereby erecting to his memory a most creditable and enduring monument. In addition to this, he built for Rochester University, Sibley Hall, for a library and museum, at a cost of $117,000, besides other benefactions, amounting in all to about half a million dollars. He is thought to have amassed a fortune not far short of $10,000,000.

Perhaps the best popular definition of a bob-tail car is a car without a conductor. There is fairly good evidence that this type of car must go, in New York. In a great city like this one man for two men's work is not sufficient. There is too much danger to life in the crowded streets of New York. There is a point where even the saving of a few dollars a month is not considered an equivalent for the killing and maiming of unfortunate passengers and pedestrians.

There may be places where the "bob-tail" car is all right, but that place is not in crowded cities.

A contest on July 4th, of hand fire engines, at Pawtucket, R. I., revives the old time before steamers, when the boys used to run with the "masheen." The contest was between an old resurrected engine, known as the "old hay cart," operated by veteran firemen of Pawtucket, and a handsome affair called the "Gaspee," belonging to the veterans of Providence. The veterans succeeded in getting a record of 191 feet 9¼ inches from the old tub, while the "Gaspee," notwithstanding its prim appearance, stopped at 182 feet 2 inches.

We have received from Secretary Hutton the ninth catalogue of the American Society of Mechanical Engineers. From this catalogue we learn that the number of honorary members is 15; life members, 7; members, 704; associates, 35; and juniors, 43. An addenda to the catalogue shows a material increase in membership over that given in the regular catalogue.

Those who flattered themselves that the corner in sugar, brought about by the operation of Claus Spreckels, covering, it is said, about $2,000,000, would work an injury to the sugar trust, are doomed to disappointment. The only effect will be to increase the price of refined sugar, the public paying the difference, just as it generally does in the case of little pleasantries of this sort.

Minnesota's supreme court has just decided that a railroad company is not entitled to fare from a passenger for whom it fails to provide a seat.

The opinion is fast gaining ground in England that eight hours will soon be the limit of a day's work.

English Boiler Inspection.

By W. H. Booth.

TENTH PAPER.

So far little has been said upon the power of resistance of furnace tubes against collapsing pressure from without. Before the days of Fairbairn, it was believed that a tube pressed from without by fluid pressure was equally capable of resisting such pressure, whether long or short. Internal tubes had, however, frequently failed and caused fatal accidents, and finally, Fairbairn, of Manchester, instituted a series of experiments to determine, if possible, what laws governed the resistance of tubes. He concluded as one main result of his experiments that the strength of a tube was inversely as its length. The experiments in question were made with tubes, both butt-jointed and lap-jointed. Now the lap joint would cause the tube to vary fully a quarter of an inch from the true circle, the material of which they were made being .14 of an inch in thickness. In the butt jointed tubes of course, the truly circular form of cross-section could be maintained, and the resulting difference in the strength of two such tubes showed about 30 per cent., the resisting powers being almost as 7:10, thus showing the extreme importance of preserving the truly circular form. When large deviations from the circular form were made, as in the case of elliptical tubes upon which experiments were made, Fairbairn found that the rule for ordinary tubes would hold good for the elliptical tubes, by supposing these to have a diameter equal to that of a circle corresponding with the largest radius of curvature of the ellipse. Thus calling M the major semi-axis of the ellipse and N the minor semi-axis, the diameter of the larger circle of curvature is

$$d = \frac{2\,M^2}{N}$$

Thus in a Galloway boiler or the old type having a major semi-axis of say 2½ feet and a minor semi-axis of 1⅝ feet, the osculating circle would have a diameter of 9 feet, and would therefore collapse when an ordinary 2 ft. 9″ circular tube would have a marginal factor of 3. Hence the necessity of the many vertical tubes in the elliptic flue tubes, without which it would very speedily collapse.

Fairbairn's experiments were fairly numerous, but, being made on comparatively small tubes, are not now usually considered specially suited to modern practice. The rule which was deduced from the experiments reads as follows:

$$P = \frac{806300\ t^{2.19}}{L\,d}$$

where P is the collapsing pressure per square inch in pounds, t is the thickness in inches of the tube and L is its length in feet; d being the diameter in inches. From the fact that the longitudinal joints should break joint instead of being placed in line, it was considered that in place of $t^{2.19}$ the quantity t^2 simply might be employed, so avoiding the use of logarithms in the solution. Fairbairn supposes that the circular form is not departed from to any greater extent than double the plate thickness.

For welded or butt-jointed marine furnaces the English Board of Trade rule is

$$W = \frac{90000\ t^2}{(L+1)\times d}$$

W being the working pressure in this case and t, L, and d, having the same signification as before. If this rule does not give an excessive pressure it is allowed, but the Board provide also that in no case without special permit will W be allowed to exceed

$$\frac{8000\ t}{d}$$

thus practically limiting the stress in the material to 4,000 pounds per square inch of section of material. In both Fairbairn's and the Board of Trade rules the length L is measured between joint rings if these exist. For lap joints 70,000 takes the place of 90,000, and for inferior workmanship or material, still further reductions require to be made, according to the judgment of the surveyor.

Fairbairn's tubes were of very thin material and it would appear as though the substitution of the fractional index 2.19 by the simple square was a mistake, the increase thus caused being greater than the facts would warrant, and not borne out by practice. The collapse of so many flues which appear safe by the rule, is a further proof of its excess allowance, and in place of a marginal factor of 4, it is only too probable that 2 or even 1½ are nearer the actual thing, and that many tubes are dangerously overpressed. In addition to determining tube strengths by formula of the nature given, it is well to consider also, as is done in the limiting Board of Trade rule, what is the actual compressive stress in the material of the tube itself. Let us take first the case of the tube tested, we believe, in 1876, at Washington, by the U. S. Government engineer. This tube was of large size, being no less than 54 inches diameter and 36 inches in length made of ¼ inch plate. It showed signs of distress at 100 pounds, but being stayed, it went on to 130 pounds before again bulging, and finally failed at 128. But for the shoring up it must have gone at 100 pounds, at which it first showed a bulge.

By rule with $t^{2.19}$ the tube should have stood 239 pounds. At 100 pounds the stress in the material was

$$\frac{100\times 54}{.5}$$

or 10,800 lbs. per square inch.

After the experiment, the furnace as actually used had three rings of 2 feet 3 inches each, in place of two rings of 3 feet, and it was made from half-inch plate instead of quarter, and worked at 80 pounds.

In 1878 the Leeds Forge Co. constructed an experimental 7 foot tube of 37 inches internal diameter and ⅜ thick. This tube, which should have stood 363 pounds by the rule with index 2.19 only stood 200 pounds before failure, or the equivalent of 9,860 pounds per square inch of section.

Fairbairn experimented on a long 35 feet tube of a diameter of 42 inches and ⅜ inch thick. It stood 97 pounds. By the rule it should have stood only 62 pounds. Probably the ring joints helped to support it, but as the compression in the material could only be 5,130 pounds per inch, we see that it must have been due to the great length that the tube collapsed at so small a pressure.

Another similar tube, but only 25 feet long, which should have stood by rule only 89 pounds, actually did stand 127 pounds, and then was compressed 7,110 pounds per inch of section. Compared with the last example the strengths are very nearly as the inverse ratio of lengths.

A tube 60 inches long, 14⅜ inches diameter, and made of ½ inch plate in three rings of 20 inches each, failed when tested by Fairbairn at 125 pounds, though by the rule it should have stood 116 pounds only. No doubt the rings helped in this case also, but we again note the compressive stress to be 7,312 pounds.

These few tests would seem to point out that in tubes whose length is four times their diameter we may figure upon a stress in the material of 7,300 pounds, and in tubes of ten diameters long, of about 5,400. The Washington and Leeds forge tube, of about 1½ and 2 diameters, withstood about 11,000 and 10,000 pounds respectively.

If we now examine these figures with care, and remember that in the longer tubes any excess of strength may reasonably be laid to the credit of the cross joints, we shall be able to show, what has hitherto been overlooked, that the compressive resistance of the material of a tube varies inversely as the square root of the ratio of the length of tube to its diameter; that is to say, the following calculation will give nearly the same result for all tubes. "Divide the length of tube by its diameter and multiply the square root of the quotient by the compressive stress." To find the compressive strength:

"Divide the length by the diameter; then 15,000 divided by the square root of the quotient will be the ultimate compressive strength of the material. Let us even apply this rule to a corrugated furnace. One was tested by the Leeds Forge Co., which had a length of 7 feet, and a diameter of 37 inches. The corrugations were 6 inch pitch, and this is the true length for our calculation. Now we have 6 inches ÷ 37 = .162 and $\sqrt{.162}$ = .4.

Now 15,000 ÷ .4 = 37,500 pounds. Here our rule fails, for the actual test showed 22,200 pounds, corresponding to 450 pounds' pressure. Here, however, we have attained to the limit of elasticity of the material, so that at least the corrugations have given the material an opportunity of developing their maximum possible resistance, and we may well limit all cases to 20,000 pounds' stress.

Revised Index Table.

By A. B. Landis.

The Brown & Sharpe universal milling machine dividing head, with its table for indexing, is an excellent arrangement, but I have often wondered why they don't make a more complete index table. For some dividing a great many index circles can be used for the same thing, and thus avoid changing index plates, which the table would indicate must be done; and again, when dividing of same kind is often done, it throws the wear all on one index circle, when it could be divided over several. I will here give a part of a table, such as I made for use on this machine, and I have found it to be a great convenience and saving of time. The first index circle given with each division is the one given in Brown & Sharpe's index table. The table I made is too large to give here in full, but it will give the reader a clear idea, and, by a little calculation, he can himself make a complete table. I added other index circles to the machine I used, so that all numbers to 100 can be divided, which makes it more complete. The idea that other circles could be used when first putting this machine into use never occurred to me, as I thought the manufacturers would have it in the table if it could be done, but, after calculating, I found the result as shown. Thinking that some others may be laboring under the same impression, I contribute it to these columns:

REVISED INDEX TABLE.

No. of Teeth.	Index Circle.	No. of Turns.	No. of Teeth.	Index Circle.	No. of Turns.
2	Any	20	17	17	$2\frac{6}{17}$
3	39	$13\frac{12}{39}$	18	27	$2\frac{6}{27}$
3	33	$13\frac{11}{33}$	18	18	$2\frac{4}{18}$
3	27	$13\frac{9}{27}$	19	19	$2\frac{2}{19}$
3	21	$13\frac{7}{21}$	20	Any	2
3	18	$13\frac{6}{18}$	21	21	$1\frac{19}{21}$
3	15	$13\frac{5}{15}$	22	33	$1\frac{17}{33}$
4	Any	10	23	23	$1\frac{17}{23}$
5	"	8	24	39	$1\frac{26}{39}$
6	39	$6\frac{26}{39}$	24	33	$1\frac{24}{33}$
6	33	$6\frac{22}{33}$	24	27	$1\frac{18}{27}$
6	27	$6\frac{18}{27}$	24	21	$1\frac{14}{21}$
6	21	$6\frac{14}{21}$	24	18	$1\frac{12}{18}$
6	18	$6\frac{12}{18}$	24	15	$1\frac{10}{15}$
6	15	$6\frac{10}{15}$	25	20	$1\frac{15}{20}$
7	49	$5\frac{35}{49}$	26	39	$1\frac{30}{39}$
7	21	$5\frac{15}{21}$	27	27	$1\frac{21}{27}$
8	Any	5	28	49	$1\frac{21}{49}$
9	27	$4\frac{18}{27}$	28	21	$1\frac{16}{21}$
9	18	$4\frac{8}{18}$	29	29	$1\frac{20}{29}$
10	Any	4	30	39	$1\frac{26}{39}$
11	33	$3\frac{21}{33}$	30	33	$1\frac{22}{33}$
12	39	$3\frac{18}{39}$	30	27	$1\frac{18}{27}$
12	33	$3\frac{11}{33}$	30	21	$1\frac{14}{21}$
12	27	$3\frac{9}{27}$	30	18	$1\frac{12}{18}$
12	21	$3\frac{7}{21}$	30	15	$1\frac{10}{15}$
12	18	$3\frac{6}{18}$	31	31	$1\frac{24}{31}$
12	15	$3\frac{5}{15}$	32	20	$1\frac{15}{20}$
13	39	$3\frac{3}{39}$	32	16	$1\frac{12}{16}$
14	49	$2\frac{42}{49}$	33	33	$1\frac{25}{33}$
14	21	$2\frac{18}{21}$	34	17	$1\frac{13}{17}$
15	39	$2\frac{26}{39}$	35	49	$1\frac{28}{49}$
15	33	$2\frac{22}{33}$	35	21	$1\frac{15}{21}$
15	27	$2\frac{18}{27}$	36	27	$1\frac{18}{27}$
15	21	$2\frac{14}{21}$	36	18	$1\frac{12}{18}$
15	18	$2\frac{12}{18}$	37	37	$1\frac{26}{37}$
15	15	$2\frac{10}{15}$	38	19	$1\frac{19}{19}$
16	20	$2\frac{20}{20}$	39	39	$1\frac{27}{39}$
16	18	$2\frac{9}{18}$	40	Any	1
16	16	$2\frac{8}{16}$			

Observations in the Shop.

By H. C. Balsbaugh.

In the ordinary rounds of the observing workman he frequently comes across defects in the details of machine tools that he reasonably concludes should not exist.

Why they exist may be explained in a manner, but not in a manner that will make their existence satisfactory to the man who continually comes in contact with them. If a machine tool designer would occasionally consult a practical workman, even if only in reference to details, something might result that would benefit both maker and user of machine tools. Not that the practical workman knows more of the business, as a whole, but because he sees in his daily work, his daily handling of a machine, bad points that the designer will never know unless he finds it out through the workman.

If the designer is a practical workman himself, if he came up in successive steps from the positions of cleaning castings and cutting bolts and tapping nuts by hand and by machinery, to the position of draftsman and designer, then truly he reasonably ought to be master of the situation. Such men, however, are scarce, but the fact cannot be disputed that such men are very much needed.

A leading machine tool firm has now for some years employed a few features in one of their machines that are inconvenient and a continual annoyance. Apparently they do not regard it worth noticing, but every good workman that handles that machine condemns these parts, and so would the man that made the machine if he had to operate it; and so of machines of various makes.

A machine should be made as convenient as possible down to the smallest detail, for it all saves time, saves the machine from an occasional blow of the hammer or wrench, and saves a man from exhibiting a bad temper. Tool builders may grow old in their business, they may have various standards in their minds which they believe in upholding, yet their products will never be so perfect but that the men that operate them can point out weak spots and omissions as well, that have no business to be there.

Let nothing in this article be construed to mean that the hastily formed ideas that often crop out in times of a difficulty in exceptional work, should be adoped; not at all; but when a good sensible idea for general work is suggested by a man in a blue over-suit, be as ready to adopt it and give credit as though it came from a man in a white shirt and silk hat.

Another phase of the subject which an illustration will show. A large machine, the product of one of our best firms, had a useful feature added to it recently in a very ordinary shop, which tool builders ought to have thought of, or, if thought of, ought to have adopted long ago. The improvement proved its worth from the first.

Might not something be learned if manufacturers would occasionally send their designer through the country, with a view of gathering up such stray devices as general machine shop practice has proved to be good?

LETTERS FROM PRACTICAL MEN.

Adjusting Punches Vertically.

Editor American Machinist:

We notice that "Chip," in your issue of July 21st, speaks about the difficulty of adjusting punches vertically in punching machines as ordinarily made, and of having made a device of his own which, by the way, seems to be a very good one) for this adjustment, and also having made an automatic stop motion for his machine. These difficulties are overcome in all the punching presses designed and put upon the market by us, and some other manufacturers, by making an accurate graduated adjustment to the slide-bar of the press, by which the punch can be set to any desired height in relation to the die; and in the best modern practice we never dream of building a machine without the automatic stop, which always causes the slide-bar to stop at the top of the stroke when the foot is removed from the treadle or the hand from the hand lever.

Ferracute Machine Co.

Bridgeton, N. J.

Quick Work in Building Machinery.

Editor American Machinist:

Messrs. Walter Scott & Co., Plainfield, N. J., recently built a newspaper printing and folding machine, including all castings and

even some patterns, in 30 days. It was delivered in Chicago in 4½ days after completion, and in 3 days more was printing the copies of the *Inter-Ocean* at a speed of 24,000 copies per hour. The machine measures 20 x 8 x 5 feet, weighs about 12 tons, and is made up of about 4,000 separate pieces. I am not aware of any such machine having been built in such a short time. A. W.

Chordal's Tap Puzzle.

Editor American Machinist:

In a late issue a subscriber related his peculiar experience with a tap. This prompts me to send you herewith something else in the way of a tap puzzle.

This tap was handed to me by Mr. Baxter D. Whitney, of Winchendon, Mass. The tap is a very ordinary sort of a 16-thread right-hand tap, with three flutes. Notice that there are two nuts on the tap. These two nuts were tapped with the tap. By turning the nuts you will notice that one of them is a right-hand nut, and the other a left-hand nut, and that the tap screws into and fits properly in either nut. Take off the left-hand nut, and, judging from the other nut alone, you would say it was an ordinary case of a right-hand tap. Take off the right-hand nut and use the left-hand one entirely, and you would say it was an ordinary case of a left-hand tap. How is the puzzle to be solved?

Screw both nuts upon the tap so they are against each other like lock nuts, but not tight. Hold both nuts by the fingers and revolve the tap, and the nuts separate. Turn the tap the other way and the nuts approach. Here is a principle for a right and left-hand turn-buckle, and is, so far as I know, a new mechanical movement. CHORDAL.

[We noticed, when turning this tap in the nuts, that they would not only separate or approach, but that the left-hand nut moved much faster than the right hand one, and, upon removing the left-hand nut from the tap it was found to have a double thread, while the right-hand one had a single thread; the left-hand nut is also slightly looser on the tap than the right. So it seems the problem is, to account for the fact that two nuts, one having a right hand single thread 16 pitch, and the other a left-hand double thread 8 pitch, could be tapped by the same tap, it being right-hand single thread, 16 pitch.]

The Law of Falling Bodies.

Editor American Machinist:

I notice something in your paper that ended in an allusion to the relation of our knowledge of the laws of falling bodies to mechanics. As I have something new on this, I send it, as it is easily understood by any one. It is this:

Bodies in falling produce in each other energies or power to produce heat, that is directly as their masses.

If a stone falls towards the earth, or the earth falls towards the sun, or the sun falls towards the earth, they all produce in each other velocities that are directly as the mass of the producing body. That is, the velocity produced by the earth on the stone is equal to the mass of the earth; and the velocity produced in the earth by the stone is equal to the mass of the stone. The velocity produced on the earth is, by actual measurement, 314,000 times greater than the velocity produced by the earth on the sun.

Now as the squares of the velocities of bodies by their mass is the measure of the power of bodies to produce heat, and the mass of the sun is 314,000 to one of the earth, it follows that the square of the earth's velocity by its mass is 314,000 times greater than the square of the velocity of the sun by its mass. Thus, $314{,}000 \times 314{,}000 \times 1$ is 98,596,000,000 and $314{,}000 \times 1 \times 1$ is 314,000, or 314,000 times less than the energy or heating power of the other, and the sun's heat is exactly equal to the earth's energy.

So we see that falling bodies produce in each other equal amounts of heat and energy, but that the heat is produced in the larger body, and the energy in the lesser body.

This leads to the observation that the heat and energy relations of the earth and the sun, and of all separate bodies falling towards each other, is rather that of two atoms acting on each other than that of two masses.

This makes the whole science of mechanics a department of chemistry, instead of chemistry being a branch of mechanics. The practical gain is, that it explains the whole by the simple, well known rules of arithmetic, instead of as now, by the complex (and to most men incomprehensible) calculations of geometry.

WILLIAM COUTIE.

Troy, N. Y.

Hobbing Worm Gears.

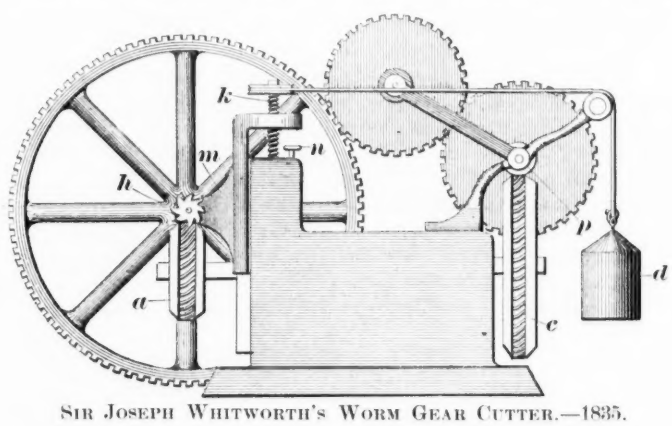
Editor American Machinist:

I stated, in the AMERICAN MACHINIST for June 30, that the positive worm gear cutting machine was not open to public use, being covered by patents owned by Morse, Williams & Co., and by the Pratt & Whitney Co.

I beg leave to withdraw that statement, as the device in question appears, on further consideration, to be wide open to anyone who chooses to employ it.

The gist of the invention is due to Sir Joseph Whitworth, whose machine is shown by the accompanying sketch.

The blank *a* to be cut is mounted on the arbor that carries the index or driving gear *c*



SIR JOSEPH WHITWORTH'S WORM GEAR CUTTER.—1835.

The worm *p* that drives the gear *c* is positively connected, by a train of adjustable gears, with the hob *h* that cuts the blank. The hob is mounted on a slide *m*, that is fed by the screw *k*, and this screw is turned by the weight *d*. The hob will be forced into the blank as it revolves, and will cut the blank continuously until stopped by the adjustable stop screw *n*.

It is difficult to see where any material addition can be made to this machine, except to substitute a positive feed for the weight feed. The several patents owned by the firms named above are for details, and for special arrangements of the device. GEO. B. GRANT.

Boston, Mass.

A Floating Saw-Mill.

Along the bayous and lagoons of Florida grows some of the finest timber in the South, much of it in places considered entirely inaccessible until J. L. Maul & Son hit upon the plan of constructing a floating saw-mill. This idea they carried into execution, and their mammoth mill, which now lies off the banks of Burton & Harrison's hammock, near Palatka, is a marvel of mechanical ingenuity. It has a length of 80 and a breadth of 40 feet, and it is so solidly built that the machinery has no more effect upon it than if it were built upon the solid land. Although it stands five feet high out of the water, its draught is only about a foot and a-half, which permits it to be taken into the shallowest lagoons where timber could not be floated. It is equipped with the latest machinery, planer, box-header, shingle saws and a fine 40 horse-power engine and boiler. On the hurricane deck is the cabin and office for the proprietor, while the cook house, where the men board, is in a corner of the main deck, which is otherwise free for the piling of lumber, the machinery being all below it. This floating mill has so far proved eminently successful, exceeding the expectations of the proprietors in this respect, and is probably the pioneer of numerous craft of the same kind.—*The Timberman.*

Shop Notes.

At Wilmington, Del., business in the shops is generally good; most of them are now and for some time past have been quite busy, though some of them report a falling off in inquiries, which they attribute, partly, to political agitation. Several of the well-known manufacturers of the place, in speaking of this, said that they thought it was entirely uncalled for, that there was no cause for alarm, and they did not expect any action to be taken by the people, or their representatives, which would result in injury to legitimate manufacturing interests. This was the universal sentiment, so far as an opinion was expressed upon the subject.

The manufacturing interests of Wilmington have been growing quite rapidly within recent years, and the new concerns, together with the older ones, make of it an important manufacturing city. One of the most important interests is the manufacture of morocco leather. There are several large "morocco factories," many tons of goat skins are imported by them, and the machinery used is considerable, giving employment to quite a number of machinists in building and keeping it in repair. A good many railroad cars are built, Pullman having large shops there, and the Harlan & Holingsworth Co. are large builders. They also do a good deal of marine work, and are now engaged on several iron ferry-boats, one for use between New York and Brooklyn. They built Vanderbilt's million dollar yacht, and she is now lying at their wharf being overhauled.

At the shops of the Betts Machine Co. they are quite busy, chiefly on heavy tools.

A HEAVY 66" LATHE.

The above company is just completing a heavy lathe for the Midvale Steel Co., who intend to use it principally for turning very heavy shafts, and forgings of steel, and rolls. This lathe is somewhat remarkable in its way, and possesses some features which are new and decidedly interesting.

The bed is of the box form, the advantages of which have been shown by Prof. Sweet. It is very heavy, weighing about 1,000 pounds per foot, and is, on account of its box form, closed up between the shears, so as to form a broad shallow trough, in which any water which may be used on the work is received, and effectually prevented from getting down into the foundation. It is closed at the foot of the lathe by a piece of boiler iron, fastened on by bolts, so that it may be conveniently removed for cleaning out, which, with this construction, can be readily done by the use of hose and a broom. The bearings for the carriage and foot-block are flat and very broad; the one in front being much wider than the other, and divided in the center by a groove, in which lies the large steel lead-screw, which is supported at intervals of 30". This front bearing of the carriage is so wide, and extends out so far as to prevent overhang of the tool rest, and in turning the largest diameters possible over the shears the carriage is solidly supported.

The head is very massive, is 7 feet in length, and provided with a forged steel spindle, the front bearing of which is 10" diameter and 14" long, and the back bearing 7"×9".

It is driven by means of an internal gear wheel on the face-plate. This gear and its pinion, together with all the other gears about the lathe, are steel castings, and are cut. The lathe is quadruple geared, and with the five-stepped cone can be driven at 20 different speeds, the ratios of the gearing being 1 to 9.57; 1 to 27.88; 1 to 89.5; and 1 to 250. In front of, and below the level of the spindle, is the shaft which carries at one end the face-plate pinion, which is always in use. Back of this pinion, and between the bearings of the same shaft, are two gear wheels of different sizes, both keyed fast to the shaft, and either one of which may be driven from a pinion on the cone-pulley shaft above. The two pinions on this shaft slide one way or the other to engage with either gear, and are fast together, so that when one is put in gear the other is necessarily drawn out. The shaft upon which these pinions are placed runs the entire length of the head, has three bearings, and at the back end carries the cone pulley, which has five steps for a 4" belt, the largest 30" diameter. The cone drives the shaft either direct, or through the medium of the ordinary back gears, which, however, are not arranged in the ordinary manner, but are all at one end of the cone, and slide on the shaft to put them in and out of gear, instead of moving in and out by an eccentric. The cone pulley is not keyed direct to its shaft, but drives a disk which is keyed fast, by means of a shearing pin, which passes through two hardened steel bushes, one of which is screwed into the cone pulley and the other into the disk. The ends of these bushes come quite close together, and the shearing pin passes through holes which are in the center of each bush. This pin is of steel, and its diameter is carefully computed to bring its shearing strength somewhat below the strength of the gears and other parts of the lathe, the object being to prevent the wrecking of the lathe by overloading, and yet allow the operator to put on all the cut he may have occasion to, without a thought as to the ability of the lathe to carry it; since, if anything breaks, it will simply be the shearing of this pin.

Motion is imparted to the lead screw in three ways—by a direct train of gearing for screw cutting; by a compound system, including friction disks, sun and planet motion, and worm wheel, for feeding; and by belts running on tight and loose pulleys, and shifted together like planer belts by a hand lever. These pulleys are at the foot of the lathe, and are for quick traverse of the carriage, giving it a speed of 7 feet per minute. The range for screw cutting is from 18 threads per inch to a pitch of 3". The range of feed is from $\frac{1}{500}$ to $\frac{7}{10}$ of an inch, with an infinite number of variations between the two extremes. Motion is given the screw for this feed by means of gearing, most of which is back of the head, but controlled by levers in front. There are friction disks, such as used by Sellers, 14½" in diameter, and which, to give them driving power, are driven at a comparatively high speed, turning 89 revolutions to 1 of the face-plate. The position of the movable disk is controlled by means of a reach-rod, which passes through to a lever at the front of the head, the disks being at the back. In the train between the friction disks and the screw is an "in-and-out pin," by which the motion is changed in the ratio of 2 to 1, and a sun and planet motion, which, when in gear, reduces it in the ratio of 20 to 1. This motion can be thrown in or out by a lever from the front, and is effected by means of a double-ended clutch on one of the pinions, which, when thrown one way, holds the pinion stationary, making the true sun and planet motion, and when thrown the other way makes the pinion revolve with the large wheel and thus gives the direct motion 20 times faster. From this

sun and planet motion a shaft runs across the end of the lathe, which at its end carries a steel worm, which engages with a phosphor-bronze worm wheel, which is on the screw next to the bearing and between it and the gear used when cutting screws. Neither this gear nor the worm wheel are fast to the screw, but drive it through the medium of a yoke, which is keyed on between them, and to which they are connected by a shearing pin passing through hardened bushes, the same as are used for the cone pulley. The arrangement is such that the gear wheel and worm wheel cannot be both connected to the yoke at the same time. The pin is calculated to shear when the pull on the carriage equals 40,000 pounds.

The carriage has a compound rest and automatic cross-feed, and besides the usual hand wheel for moving it, can be moved by a ratchet lever when desired. Just above the cross-slide is another slide parallel with it, which, by means of links which bolt on, may be connected to the sliding block of a taper attachment made upon the Slate principle, except that it is at a fixed taper, made to the order of the M. S. Co. for turning a part of their rolls which they use for rolling driving-wheel tires. The foot-stock is very heavy, is held in place by six bolts, and moved along the bed by means of a rack and pinion, the latter turned by a ratchet lever.

Some idea of the strength and driving power of the lathe may be had from a statement of the Otis Iron and Steel Co., of Cleveland, who have one of the same pattern, but without the special features and arrangement of feed motion. They stated that in their lathe a steel shaft 23″ diameter had been turned, using two tools, one of which reduced the shaft 4½ inches, and the other 3¾ inches in diameter, with a feed on both of $\frac{1}{12}$ of an inch.

The Midvale Steel Co., wishing to use their lathe for turning chilled rolls as well as for other work, it is provided with housings in which to run them in the same manner as is done in regular roll turning lathes, and it is designed to use tools 12″ wide. For this work the lathe will be run backwards; an arrangement for which several advantages are claimed, among others, that the strain put upon the roll by the cut will tend to seat it solidly in the housings, and press them firmly to the bed, thus increasing the rigidity. Then, almost as soon as the tool has been brought up to the work, its effect, and the character of the cut it is taking, can be observed by the workman, instead of having to wait for nearly a revolution to take place; which, on a chilled roll of large diameter, takes considerable time. The roll turning is not to be done by the regular tool rest, but for this there is a special fixture provided, designed to carry out the idea of the M. S. Co., and built to their order. This device constitutes perhaps the most novel feature of the lathe, embodying as it does an entirely new feature and principle in lathe construction.

It is mounted upon the carriage, which, for the time being, is clamped fast to the bed. The tools (of which there may be three) are held in a turret, and, with the lathe running backwards, the tendency is, of course, to tip this turret back away from the cut; to counteract that tendency, and prevent the resultant springing from taking place, is the object of the new feature. Just below the slide upon which the turret moves, connection is made between the block and the piston-rod of a water cylinder, upon the piston of which there is a water pressure of 60,000 pounds, tending to force the tool into the cut. Above this, at a point about level with the tool, there is attached the end of a screw, which passes through and is threaded into the hub of a worm wheel, the motion of which is controlled by a worm, which, in its turn, is driven by other gearing and a ratchet wheel. It is this screw and system of gearing which prevents the tool being driven into the work by the water pressure upon the piston; but the pitch of the screw and worms is such that they will nearly slip; about 60 pounds' pressure upon the teeth of the ratchet wheel only, being required to move it, and allow the water pressure to feed the tool in. It is thus seen that, before the cut is started, there is established an equilibrium of forces, and that the tendency of these forces is to tip the turret in the same way as the cut would. These forces are calculated to be greater than ever put upon the tool by the cut, and, consequently, the tool is sprung to the fullest possible extent before the cut begins, and in the same direction as the cut would tend to spring it. Now, when the cut is started the equilibrium of forces is still maintained, and there is no more force tending to tip the turret than before; because whatever strain is put upon it by the cut, is taken off from the screw which is resisting the hydrostatic pressure, and at all times the strain due to the cut, and the strain on this screw, acting in the same direction, are together, equal to what was on the screw alone before the starting of the cut; and they are also together just sufficient to balance the hydrostatic pressure. To make this clear, suppose the resistance necessary to be exerted by the screw to prevent the water pressure driving the tool into the work is 30,000 pounds; if the strain put upon the tool by the cut equals 10,000 pounds, the only effect will be to relieve the strain upon the screw to that extent, reducing it to 20,000 pounds; and as long as these two forces act in the same direction, the total strain tending to tip the tool back will be 30,000 pounds, as before. If the strain imposed by the cut rise to 30,000 pounds, then the hydrostatic pressure will be just balanced as before, but the screw will be entirely relieved of strain. Of course, owing to the friction of the arrangement, the force required to be exerted by the screw will be considerably less than that of the water, but it is calculated to always exceed the strain caused by the cut. There are two sets of these forces, which may act together, or singly, upon the tool, as may be desired; one acts in a line parallel to the center line of the lathe, and the other at right angles to it. We have attempted to explain the principles involved only, and cannot fully describe details, though they seem very well thought out, and no reason is apparent for its failure to work as expected. It is stated that the Midvale Steel Co. have tested the principle involved to some extent—sufficiently at least to give them considerable confidence in its success.

Among the other large tools at present under construction is a 14-foot boring mill, for the Penn. Iron Works, of Philadelphia, which is built to run the housings back by power to make the mill swing 20 feet. It will take in work 10 feet high, and will weigh about 60 tons. There are 60 changes of speed, the slowest having a ratio to the cone pulley of 1 to 232. There are two spindles of hexagonal shape, having a movement in the head of 4 feet, and there is a positive feed varying from $\frac{1}{64}$ to 1½ inches.

Hydraulic Punching Machines for Producing Washers.

Mr. Henry Berry, engineer of Croydon Works, Hunslet, Leeds, in his invention for hydraulic punching machine, that will at one operation produce a perfect and level washer, and the method of performance of same, declared the nature of his invention to be as follows: To provide a machine that shall hold that portion of the plate or flat bar from which the washer is to be formed between two opposite and opposing faces, whilst the punching of the central hole and exterior diameter is taking place. With this object in view, he provides a main hydraulic cylinder fitted with a piston, the rod or ram of which carries at its outer end a punch equal in diameter to the size of the washer to be produced; a bottom die or matrix is fitted at a suitable distance from the punch. A "pull back" cylinder of smaller area than the main cylinder is formed in the cover of the main cylinder, the pistons of the two cylinders being connected by a rod. Pressure being admitted on the larger area of the punching cylinder causes the outdoor or punching stroke overcoming the resistance of the pull back cylinder, which, having a continuous pressure on its annular surface, will, on pressure being released from the main cylinder, cause both pistons to ascend and make the return or indoor stroke. A third cylinder provided with ram, and having a continuous pressure on the underside of the ram, carries and actuates the punch for perforating the central hole of washer, the matrix for this punch being carried by the larger and opposing exterior punch. The ram carrying the central punch has an interior and annular cylinder formed within it, and is provided with an annular piston, having also continuous pressure on its under surface; the annular piston or ram being turned to two diameters will leave a shoulder or abutment, against which bears a collar or ring, enclosing the smaller diameter. This ring serves two purposes, (1) as a stop, preventing the punching and annular rams being forced out of their respective cylinders; (2) as a holding up ring, as afterwards explained. A valve controlled by hand, foot, or power, admits and releases pressure from the main punching cylinder, and is the only valve employed. The action of the machine is as follows: The interior punching and annular bearing-up rams being in their highest position, a plate or bar is placed upon their upper surface; the valve applying pressure to the main punching cylinder being now operated will cause the main punching piston to make its outdoor stroke, meeting in its progress the bar or plate held up by the interior punching and holding up rams; the main piston and punch continuing to descend will carry the bar or plate with them, the interior punching ram not giving way, the interior punching will take place, the main piston continuing its descent carries the annular holding up ram before till the bar or plate is in contact with the exterior matrix, when the washer is completed by the outer diameter being punched, it will now be seen that the ring-like stop on aunular ram forms a holding up service between the interior and exterior punch, ensuring the washer being kept level during the punching process and preventing the bending of the bar or plate, which will ensue but for its action. It will be evident that the machine can be arranged to work in any position, and that other than circular washers can be produced.—*Iron Trades Advertiser.*

Burning Bituminous Coal.

By W. E. Crane.

When burning bituminous coal we have elements that require different treatment from anthracite. We have the hydro-carbons that volatilize at a low temperature, and unless the furnace is made especially for it, or care is used in the management of the fires, they will pass off unconsumed.

The tendency of this coal to coke causes large air-holes to form, and at times large volumes of air will pass through in a body, which will also interfere with combustion. On account of the hydrogen contained it requires more air than hard coal, and it also has more heat units. Its smoky nature makes it objectionable, and many imagine the smoke to be carbon, and the loss in heat from this seems very great, and for this reason smoke-consuming devices have received the greater part of their encouragement.

According to experiments made by Mr. Hoadley, the amount of carbon in the smoke of some kinds of soft coal is almost imperceptible, and economy from burning smoke, so called, is generally a delusion.

Smoke-burning devices usually consist of some method of admitting air above the fire, while if sufficient air passes through the grate, as should be the case, or, if there is one or more large air-holes, as is very apt to be the case, the air admitted will be greatly in excess of practical requirements, and although the smoke may be prevented, it will always be at a loss.

The practice of keeping thin fires and spreading the coal thinly requires the highest skill and careful attention, to avoid air-holes breaking through, and to keep the fire up to its work all over the furnace, especially if the amount burned per square foot of grate does not exceed ten pounds per hour. To get the best results there must be sufficient heat to ignite all the gases, and sufficient air to consume them, and the coal must be put on in such a manner that the gases and volatile portions will not distill faster than they can become mixed and heated up to the point of ignition.

To be sure of sufficient heat it is sometimes the practice to build a roof of fire-brick over the fire, which produces an intense heat in the furnace, and insures sufficient heat to ignite all the gases if there be sufficient air. The supply of air with this method will not be sufficient, as, when fresh coal is thrown into this highly incandescent chamber, the distillation of its gases will be so rapid that no ordinary supply of air will suffice, and if provisions be made for a sufficient supply at the time coal is put in, it will be greatly in excess after the gases are distilled.

Another loss from this method will be the extra radiation through the furnace walls, owing to the intense heat of the fire, and also the boiler losing the radiant heat from the fire, which amounts to more than is usually credited.

The practice that gives the best results is known as the coking process, by which the coal is coked before it is allowed to burn. The coking of the coal takes some little time, depending on the heat of the fire, and during the coking the gases are distilled slowly and fairly evenly; the fire itself is a coke fire, and, being open, allows sufficient air to pass through for the combustion of the coke, and the distilled gases as well, without danger from air-holes, while the heat is constantly maintained.

The question with this is, what is the best arrangement of furnace for coking?

The coking plate placed in the mouth of the furnace, of which there are several styles, is one of the best methods, but requires a change of furnace from hard coal, but would pay where it was intended to use soft coal for any length of time.

Firing by this method, the coal is thrown onto this plate, where it slowly distills, and is then pushed back over the fire and more put on the plate. A furnace like this requires the grates to be shortened, so as to allow room for a plate wide enough.

Another method is to coke it on front of the grates and shove it back from there. This method is apt to rattle some of the coal through the grates, which, of course, is difficult to separate from the ashes. Still another is to cover over one side of the furnace with fresh coal, covering some two square feet of grate. When coked, this is broken up with a bar run under the fire, and the other side of the furnace covered the same way.

The fire, when coal is put on, should not be less than six inches thick, and as the coal expands when coking, it will be twelve inches thick when broken up.

Coal should not be put on thicker than will be well coked when it is time to break it up, and it should be put on sufficiently thick to prevent its burning to any extent before such time.

While trying this method some will put the coal on so heavy that it absorbs all the heat of the fire under it, and it is nearly all put out. When they break it up the larger part is still green coal, and this cakes over again, and makes a bad mess all around and the system is condemned as impracticable.

When one gets the "hang of it," coking fires will yield from six to ten per cent. economy over any other way, and require less skill and watchfulness, and a fire is always in first-rate condition. It has also the merit of producing very little smoke.

When using anthracite dust mixed with it, the same rule applies.

It will be remembered that at the Centennial it was claimed that the Galloway boiler was designed for soft coal, and a special test was allowed them, which showed slightly better results. There were a number of boilers there, that, had they been tried with soft coal properly fired, would have shown a greater difference over anthracite than was shown by the Galloway. They would do this because there is a greater number of

heat units in most of the soft coals than hard.

In burning the gas coals no ordinary furnace will take care of the gas, and some special provision must be made. The bar for breaking up the fire should be of steel 1¼" diameter, and the end simply sharpened after the manner of a cold chisel. It should not be enlarged, as it only makes hard work.

With coking fires the smoke is reduced to a brown color, even when new coal is put on, and this is as low as any one can run with economy.

Mechanical stokers have the merit of keeping thin, even fires, with little smoke, as the introduction of coal is continuous, the coal evenly spread, and a little practice will regulate the air supply.

Don't wet the coal.

To Determine the Best Form of Teeth for Gear Patterns.

By Isaac Whitehead.

It generally falls to the lot of the pattern maker to decide the best form of teeth suited to the different circumstances to which gears are subject. For instance, when required to work into an old gear, or to construct a single pair for a special work. In treating this question I will try to illustrate the principles involved, and then the general practice I have met with in some of the leading shops in England and in this country.

There has been much study and writing to demonstrate the theory of the principles involved, upon which I will not dwell more than is necessary to guide the workman in laying out the best form. The chief principle aimed at is to have the points of contact or the direction of the force as near a right angle to the path of center at the pitch line as possible, and that the line of action shall be a straight line.

The general application of these principles to the designing of teeth is by the adoption of the epicycloidal and hypocycloidal curve, formed by rolling a circle outside and inside the pitch circle of the wheel, respectively, though any curve might be used that could be made to roll upon the pitch lines conveniently. For our purpose the curves may be constructed as shown in Fig. 1. Let *A* and *B* be the axis of two gears; *F E* and *H D* parts of pitch circles in contact at *C*. Take a circle *T* as a describing circle, which shall have a marking point at *C*. Now let these three circles roll in contact at the same linear velocity through the arcs *C S*, *C R* and *C O*, each of which is the same length. In this motion the marking point at *O*, in describing circle *T*, will have traced the curves *S R* and *R O* on the planes of the lower and upper pitch circles, respectively. *S R* is the epicycloid curve traced by rolling the circle upon the arc *H D*, while *R O* is the hypocycloid formed by its rolling upon the inside of arc *F E*. Let us suppose *C S* to be the pitch of the teeth, and *L S* the thickness; then reproduce the curves *R O* at *C X*, and *S R* below *C*; also at *L* and *M*. It is evident that these curves will act together correctly as parts of outline of teeth; *C* and *R* show the curves in contact, and if *B* is turned to the right it will drive the wheel *A* before it, and in its course the point of contact will change from *C* to point of tooth *R*, and it is also clear that the line of contact or the direction of force will pass through *C*; thus showing the velocity ratios to be constant as required.

This form of tooth shows the whole principle of action, but is only the face of tooth on driver *B* working into the flank tooth of follower *A*. In practice it will be noted that the longer the face of the tooth the greater is the angle of action *V C R* engaging more teeth, and thus adding both faces and flanks to the same wheel, thereby giving longer contact and shorter faces, and also securing less sliding upon the teeth. It is impossible to construct teeth that will work together by a purely rolling contact, when there is more than one tooth engaging at one time; and then only at the point *C* can it be said to so act, for it must slide just in the ratio that the pitch lines diverge from each other on each side of the point *C*, and to the extent of their engagement in contact.

How to Choose the Most Suitable Describing Circle.

The same size circle or curve that is used to form the face must also be used to form the flank on which it runs. The size of this circle in its relation to the pitch circle can be determined from the following considerations:

In Figs. 2, 3 and 4 are shown the effect of three sizes of describing circles used on the same size of pitch circle. In Fig. 2 we have the describing circle *T* larger than the radius of pitch circle, and which describes the curve *R S* running outside the radius line, thus causing the tooth to be weak at the base. In Fig. 3 the diameter of circle is equal to the radius of the describing circle, and the marking point will describe a straight line on the diameter of the pitch circle. Fig. 4 shows the describing circle smaller, having the effect of forming a curve inside the radius line, making a much stronger tooth than in the two former cases. It will be noticed that the first tooth, Fig. 2, will have the least angular pressure against the journals, with the same arc of action, and therefore for light work, as in watch making, can be used with advantage. Fig. 3 is very often used, even in heavy work, when the pinion is small compared to the wheel, and then, to strengthen the teeth, it is "shrouded" or flanged on each side, to cover and connect the ends of the teeth, and also by placing a small corner fillet at the root of the teeth, which is a good practice upon teeth in any case, as it increases the strength much more than the weight of metal.

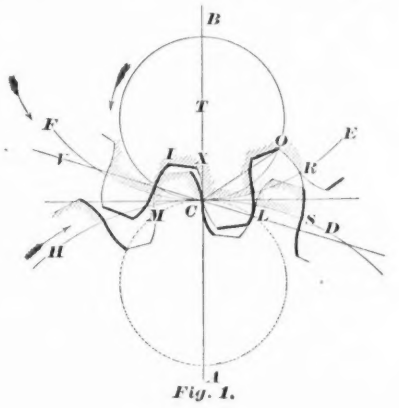


Fig. 1.

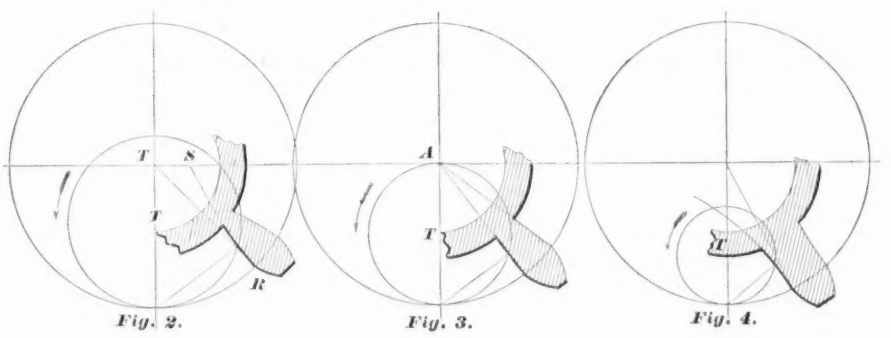


Fig. 2. Fig. 3. Fig. 4.

Form of Teeth for Gear Patterns.

From these considerations it will be seen that it is desirable to have as large a describing circle as the strength of tooth will admit. For instance, if we have two wheels, one 6" diameter, to work into another 60" diameter, then we cannot have over a 3" describing circle for the flank of the pinion and face of the wheel; but in case the pinion is the driver, then the face of its teeth and the flank of the wheel teeth may with advantage be formed by a larger describing circle, thus decreasing its angular pressure. Under these circumstances wheels would be required to work in pairs, for if it was desired to run a 60" diamater into this 60" wheel, or a 6" with this 6", the same describing circle must be employed throughout. There are some large firms that choose a describing circle small enough to cover the range in greatest demand in their class of work, thus making them interchangeable.

Other systems have been drawn up, based upon these principles, by which wheels are made interchangeable, and which are very generally used in practice.

Involute Form of Tooth.

Another form of tooth very generally used for small gears is the involute. It possesses all the properties that are necessary for correct running gear, as will be seen by the construction of Fig. 5. Let *A* and *B* be the centers of two pitch circles in contact at *C*. Through *C* draw *D D* at any angle to *A B*, the line of centers. In general practice this angle is about 17°, for reasons which will be seen as we proceed. Upon *D D* draw the perpendiculars *A E* and *B F*; with these as radius, draw the inner circles as shown. Let us suppose these inner circles as disks, upon which is wound a thread kept in equal tension, and the thread running off the disk *A* upon the disk *B*, as shown by the arrows. With a marking point on the thread at *E*, allow the disks to revolve, and the marking point in its course from *E* to *C* will have traced the curve *H C*, and from *C* to *F* the curve *C I*. It will be seen that the curve traced by the point *E* upon the paper, revolving with disk *A*, as it leaves the disk in its course to *F*, will be *H I*, while the curve traced upon the paper by disk *B* will be *O N*, and thus it will be seen that the face *H I* has acted upon the face *O N*, with the line of contact constant in the line *D D*, proving constant velocity ratio.

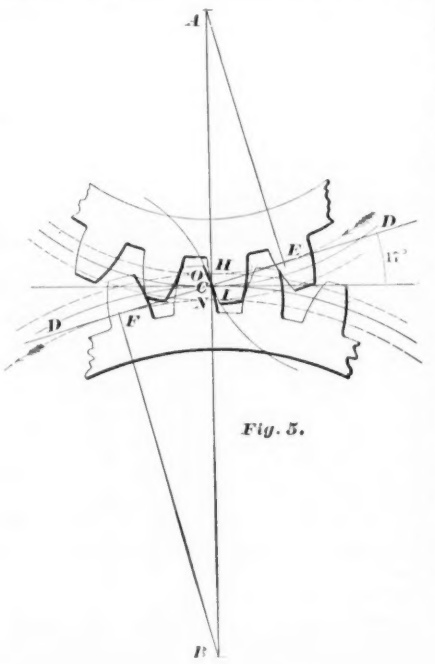


Fig. 5.

It will be noticed that the driving inclination is on a line with this angle, which is an objection against this form for heavy work, to which the epicycloidal is not open, in which the angle of the driving varies, and when on the line of centers is perpendicular to that line.

Yet there are many advantages in the involute form, for, as the line of action was drawn at pleasure, so it follows that any sizes of wheels may be made to run with each other perfectly, the pitch being the same, it simply changing the angle of the driving contact.

The clearance of teeth may be brought down to a minimum by bringing the centers closer together, and in the course of wear the gears will always gear correctly, so long as they engage at all. It also has the advantage of being a strong tooth. I have described the forming of the curve from a point on a string, connecting two disks, so as to show the truth of its action in driving, but the involute curve may be formed by unwinding a string from each disk, or with a straight edge; rocking its face upon the circle. The end of straight edge as it leaves the circumference will describe the required curve.

Breathing in Smoke.

On Tuesday last there was an exhibition on a piece of land adjoining Victoria Mansions, Westminster, of Loeb's appliances which are designed to enable the wearer to breathe and work with comfort in dense smoke, and also in poisonous gases. The appliance consists of a respirator with an india rubber mouthpiece. The respirator is held by two projections, which are grasped between the teeth and a flange, which lies between the teeth and the lips, additional security being provided by an elastic band passing round the head. The air is drawn in by the wearer through a series of small filters, containing respectively wet sponge, cotton wool, cotton wool damped with glycerine, and animal charcoal. These filters are very lightly packed, so that there is no resistance to the act of inspiration, and they are provided with valves which direct the air expired from the lungs into the external atmosphere. The entire apparatus weighs less than a pound, and can be used without previous practice. When it is to be employed in an atmosphere which is deadly in its character, as in the choke damp of mines, the air is drawn from some place where it is pure, through a light india rubber tube. The filter is then strapped to the waist of the wearer, and the respirator merely contains the valves which cause the air to be drawn through the pipe and then to expire into the atmosphere. A tube up to 100 feet in length can be manufactured with facility. Protection is afforded to the eyes by a pair of spectacles with india rubber rims, which press tightly on the cheek and brow, and exclude all smoke. Mechanical wipers are added, to enable the glasses to be cleaned without removal. On Tuesday a man wearing the respirator spent half an hour in a building filled with dense smoke of a most pungent character, without any difficulty, and afterwards the inventor's representative, with the aid of a flexible air pipe, entered a room containing a dish of burning sulphur and remained there some time. It was clearly demonstrated that the respirator would enable the wearer to enter a building filled with smoke and discover the exact position of a fire. A few buckets of water promptly applied under such circumstances will do more good than the jet from a steam fire engine directed at random. On board ship, where the result of a fire is to fill the hold with smoke, this respirator would be most useful, and this fact has been recognized in the German navy, where Loeb's respirators form part of the official equipment. Many of the German fire brigades have also adopted them. They are being introduced into this country by the Fire and Mining Appliances Syndicate, of 49 Queen Victoria street, E. C. —*Engineering.*

M. E. Ducretel, of Paris, has devised a filter for filtering the oil used in lubricating gas engines. An unnecessary quantity of oil is generally used for this purpose, and it is important to save as much of it as possible. In the device referred to the heat of the escaping gases is used to raise the temperature of the oil, thus facilitating filtration.

A contemporary, assuming the role of critic, gravely informs the writer criticised that the capacity of two steam cylinders, each $2\frac{3}{4}'' \times 2\frac{1}{4}''$, is equal to that of one cylinder $3\frac{7}{8}'' \times 4\frac{1}{2}''$, the revolutions in each case being 300. Comment would be superfluous.

It is expected that not less than 5,000 locomotive engineers will participate in celebrating the twenty-fifth anniversary of their organization at Detroit, August 17.

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☞ *We are not engaged in procuring patent rights, or in selling machinery, nor have we any pet scheme to advance, or hobby to ride.*

☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

☞ *Subscribers can have the mailing address of their paper changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once.*

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$2.50 a year in advance, postage prepaid in the United States, Canada and Mexico.
$3.50 a year to Other Countries, postage prepaid.

Advertising.

Transient, 35c. per line, each insertion.
" Business Specials," 50c. a line.

The American News Company,
Publishers' Agents, New York.
The International News Company,
11 Bouverie Street, Fleet Street, London, Eng., will receive subscriptions for the American Machinist, at 14/7 per annum, postage paid.

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NEW YORK, AUGUST 4, 1888.

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Weak Railroad Bridges.

Within the past few days there have been accounts in the daily press of the giving way of no less than three railroad bridges; the most serious accident of the kind being the failure of a trestle on the Virginia Midland Railroad, on the morning of July 12, near Orange Courthouse, by which, according to one report, at least ten persons lost their lives, and about forty others were seriously injured.

There seems to be a regular epidemic of this sort of accidents, which has been going on now for a year or two, though they were frequent enough before the epidemic began.

As usual, in the case of which we speak, the report says: "Major Randolph, the manager of the road, says the accident was caused by the derailment of a coach, which knocked down a portion of a trestle, carrying with it the engine and cars."

Well, of course we cannot deny positively that that was the cause of the accident, but the alarming and distressing frequency of such accidents, and the apparent unanimity with which cars seem of late to keep on the track all right until they reach a bridge, seems, to say the least of it, decidedly strange.

What seems to us much more likely to be the truth of the matter is, that there are a great many railroad bridges in this country which are simply too weak for the loads put upon them.

Much of this weakness is undoubtedly due to the infirmities of age; but some of it is relative, and is due to the fact that the weight of trains has been largely increased within the past few years, and in most cases also the speed is greater than formerly, and bridges designed and built for the lighter traffic and slower speed of former days, even though they might have been amply strong for those conditions, are soon racked to pieces and destroyed by the tremendous weights, higher speeds, and greatly increased number of trains of the present time.

But, whatever the cause may be, there is a remedy; bridges can be made strong enough to stand with absolute safety any loads which may be put upon them, and the public have a right to demand that every railroad bridge in this country shall be so made; and not only have they the right to so demand, but it is their clear right to enforce that demand.

When the railroad companies balance dollars against human lives, and show plainly, as many of them do, that they consider the former of the greater importance, then it becomes necessary for the people to protect themselves, and they should do it. One such calamity as this upon the Virginia Midland, to say nothing of Chatsworth and Ashtabula, ought to be sufficient to secure the passage of such laws, and the establishment of such a system of State inspection of bridges, as would entirely remove the possibility of such wholesale murders.

Some may say that it is more within the province of a journal such as this to show how bridges may be made absolutely safe, than to find fault with their failure. But the truth is that bridges do not fail on account of the lack of knowledge as to how to construct safe ones, but because it is cheaper to construct unsafe ones and allow them to deteriorate by age.

The whole shameful business is due principally to the fact, that railroads are too much managed from Wall street; and that in many cases the directors of the roads are gambling in its stock and when their interests as gamblers require it, they cut down expenses on the roads; often, in spite of the earnest protests of the officers who are popularly supposed to be responsible for its condition; and as a result, the public, who place their lives in the keeping of the roads are sacrificed to the worship of money; and are crushed and burned to death.

We do not believe that in one-half the cases where it is claimed, the real cause of the failure of bridges is due to the derailment of engines or cars; but it is possible to provide against serious harm to the bridge resulting from even such an accident. We believe it can be done with iron and steel constructions, and, if not, then stone arches covered with earth.

In nearly every case of failure of a bridge, the cause is to be traced to a desire to save expenses, and the public should demand that the safety of trains should be the first consideration, and that economy should be made secondary to it.

A Sensible View of the Case.

Mr. Andrew Simonson, of Racine, Wis., is president of a political club, but it is very evident that, notwithstanding this, he is blessed with a good share of common sense, and knows how to express his ideas in good English, as is clearly shown by the following extracts from a letter written by him to the president of the opposing club in the same town. In this letter he says:

On my part, in behalf of the Racine Democratic Club, it is earnestly desired that the rivalry between our organizations may be strong, as becomes a lively campaign, but that it also, in view of the serious character of the issue at stake, be directed in channels which will not disturb the social and business relations of members of opposing political organizations, whose friendship should suffer no abatement because of conflicting political preferences.

And then he adds:

I therefore propose to you, as a measure best suited to political proselyting, in a city so distinguished for the intelligence of its voters as Racine, that we do what lies in our power to make the coming campaign one of appeals to the thought and judgment of our people, rather than to their emotions through competition of fireworks and smoking torches. Torchlight processions do not illumine the understanding of the man who seeks light on the economic questions of the hour, and the money they cost might, if otherwise expended, be the means of disseminating much useful knowledge among the voters, thereby conferring lasting benefit upon them and improving their citizenship.

If the presidents of all the political clubs in the country had similar ideas, and carried them out, there would be a much better prospect of the campaign resulting in some benefit to offset the harm which it will inevitably do to business and manufacturing interests.

In manufacture, a certain locality gets a reputation in some line, and all efforts to move this particular trade center are well nigh useless. The skill is there, and skill is not an article of manufacture, nor always an article of commerce. One of the best instances of this is in connection with the laundry business. Troy, N. Y., has for years had an enviable position so far as laundry work is concerned. And the result is that "Troy laundries" can be found in every part of the country. What makes Troy laundry work what it is, is the skill in this particular branch of work that is centered in Troy, and twenty years of effort have not been sufficient to produce the same degree of skill elsewhere. The nearest approach to competition is found in an appropriation of the title. For example, in the account of a recent celebration at Fort Worth, Texas, local papers make prominent mention of the display made by the "Troy Steam Laundry."

The laundry business is only one—a convenient—example. The same rule holds good in other affairs. And it goes to show what an important factor skill is in human affairs.

In our issue of July 28, the types made us say that the Brown & Sharpe reference disks were made in sizes up to eight inches. What we wrote was to the effect that they were made up to three inches diameter.

Literary Notes.

A SYSTEM OF EASY LETTERING. By J. Howard Cromwell, Ph. B.

The above is the title of a small book in which different styles of plain lettering are given. The method for forming the letters is also indicated, which simply consists of dividing any surface on which the letters are to be drawn, into squares (or parallelograms as the case may be) in pencil lines. These lines and the spaces between them serve as guides for forming the letters in ink or paint, according to the style chosen. The pencil lines are then erased, leaving the letters complete. This little book will be appreciated by draftsmen who wish to use plain letters (and yet somewhat different from the ordinary run of letters) for the titles on drawings. The book will also be valuable and useful to anyone who has had no practice in lettering, as the easy method given for forming the letters will enable a person to form the letters correctly, and with a little practice to do so quickly. The book is published by E. & F. N. Spon, 12 Cortlandt street, New York, and its price is only 50 cents.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(368) F. E. C., New York, asks: 1. For a small engine, cylinder 1⅛ inch diameter, 2 inch stroke, is a regular boiler necessary, or would a plain cylindrical vessel answer the purpose? *A.*—A small boiler containing the fire-box will give you better satisfaction than a plain cylindrical vessel. 2. If the plain cylindrical vessel is used, would any arrangement have to be made at the point of application of heat? *A.*—Yes, you will have to make some arrangement for a chamber to contain the fuel. 3. Is the steam led directly from the boiler to steam chest? *A.*—Yes. 4. Would it injure the usefulness of a flat pulley, if I grooved the center of the face sufficiently to take a sewing machine belt *A.*—Yes.

(369) D. K., Minneapolis, Minn., writes: I have a pleasure boat on one of our lakes here. Her engines are compound condensing, and hammer very bad, also use too much steam. The valves had 7-16 inch inside lead, and none outside. I changed the valves to a certain degree, and reduced the inner lead to 1-16 inch on the low pressure cylinder, but the engine still hammers, but does not use near as much steam. She is driving a four-foot wheel of eleven foot pitch, at the rate of about 200 revolutions, and makes nearly 20 miles an hour. Would like your advice as to the stopping of the hammering. *A.*—We should give both valves about 1-64 outside lead, and if there is any inside lap, cut it out. If we had a drawing of the valve motion we would be in a better position to advise you. The hammering may also be caused by the engine being out of alignment.

(370) M. H., Buffalo, N. Y., writes: Will you please inform me how car journal brasses are lined with lead in large brass foundries that make a business of making lead lined journal brasses for railroad cars? Also has Hopkins, or any other person that you know, a patent on the process of lining brasses with lead, or the use of lead on the brasses? *A.*—There are two ways of lining brasses with lead. First, some times brasses are lined with sheet lead; this manner of lining them is patented. Second, the lead is cast on to the brass, and on this process there is no patent. This is accomplished in the following manner: The concave surface is first coated with a thin coat of tin. To do this the brass must be carefully cleaned, and care be taken that no grease spots are left: it makes no difference whether the brass be cleaned mechanically or chemically. In brass foundries the brasses are generally cleaned by dipping them while warm in muriatic acid, after this the surface is tinned. The object of the tinning is to make the lead stick. After the brasses are tinned they are placed near a mandrel of the required size; the space between the mandrel and the surface which is to be lined with lead, must be equal to the required thickness of the lead: the lead is then poured between the mandrel and the brass.

(371) J. S., ———, writes: I would like a correct rule for figuring the pitch diameter of gears; I have a rule, but it gives only three different pitches. *A.*—A rule which can be applied to only three pitches is, of course, no rule at all, and we cannot imagine how such a rule could be formulated. If you want to figure the pitch diameter from the diametral pitch, the rule is

$$D = \frac{N}{P}$$

where D = the pitch diameter, N = the number of teeth in the wheel, and P = the pitch. Example: Required the diameter of a gear having 45 teeth, 8 pitch. $45 \div 8 = 5\frac{5}{8}$ inches, the pitch diameter of the wheel. If circular pitch is used the rule is

$$D = \frac{P\,N}{3.1416}.$$

Example: Required the diameter of a gear having 45 teeth ¾ inch pitch. $45 \times \frac{3}{4} = 33.75 \div 3.1416 = 10.743$ inches. If the chordal pitch is used the rule is

$$D = \frac{P}{\left(\frac{180^\circ}{N}\right)\text{sine}}$$

Example: Required the pitch diameter of a gear having 45 teeth ¾ inch pitch. $180^\circ \div 45 = 4^\circ$, the sine of which is .0698 and $\frac{3}{4} \div .0698 = 10.745$ inches.

(372) J. H. E., Woburn, Mass., writes: I have had to put in some gas burners for heating brands, and do not get heat enough. There are three brands on three floors, one on each floor, and air is supplied by a blower situated on middle floor. Blower pipe three inches, reduced to one inch at burner. Gas through from six to twelve feet of ⅜ inch pipe reduced to ¼ inch at burner. Now, 1, what should be the proportion of gas and air opening? *A.*—The proportions of gas and air admitted should be regulated by the use of cocks in the supply pipes. Adjust cocks to give best results. 2. Should air be introduced in the center of, or around the outside of gas? *A.*—We believe that, if you will follow the principles of the "Bunsen burner" you will obtain satisfactory results. This burner simply consists of a small tube placed inside of another larger tube, the latter extending some distance above the smaller one. The purpose of the small tube is to convey the gas into the large tube; the purpose of the large tube is to form a chamber in which the gas and air are mixed. The air is admitted into the large tube through small holes drilled in the tube a little below the opening or top of the small tube, so as to cause the escaping gas from the small tube to produce what is called an induced current of air in the large tube, in which the air is mixed with the gas, and the mixture burned at the end of the large tube. The flame from such a burner gives hardly any light, but the heat is intense. 3. Should both tubes be the same height as in Fig. 1? *A.*—No. 4. Should both discharge into the air or into a sort of chamber, and there mix and discharge from one opening, as in Fig. 2? *A.*—Both should discharge into a chamber, as in the Bunsen burner.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

See Grant's Gear advt. on back page.

Link-Belting.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link Belt Machinery Co., Chicago and N. Y.

See our new designed engine lathes in Cincinnati Centennial Exposition, Lodge, Davis & Co.

See our new designed drill presses in Cincinnati Centennial Exposition, Lodge, Davis & Co.

See our new designed shapers in Cincinnati Centennial Exposition, Lodge, Davis & Co.

See our new designed brass working tools in Cincinnati Centennial Exposition, Lodge, Davis & Co.

2,000 feet of space in Cincinnati Centennial Exposition, Lodge, Davis & Co.

See special ads. pages 15 and 16, Lodge, Davis & Co.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Lamb Knitting Machine Co., Chicopee, Falls Mass.

Machine work and pattern making. Anderson Machine Works, Peekskill, N. Y.

The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

R. Dudgeon, 24 Columbia st., New York Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells & Co., cor. Fulton and Dutch sts., New York.

"Swift" Sight-feed Lubricator; no glass tubes; simple, reliable. Swift Lub'r Co., Elmira, N. Y.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Drawings, mach. patterns and models. Inventors' ideas perfected. Valentine, 15 Alling st, Newark, N.J.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 120 Liberty st., N. Y.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Brown & Sharpe Mfg. Co., have a line of machinery with S. A. Smith, 23 S. Canal st., Chicago, Ill.

Patents—Whittlesey & Wright, 705 8th st., N. W., Washington, D.C. Send for pamphlet and references.

Ice and Refrigerating Machines, 124 built, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co. 138 Jackson st., Chicago, Ill.

Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers. Frasse & Co., 92 Park Row. N. Y.

Most sensitive and durable Damper Regulator made; works within one pound; send for circular. T. Kieley, 11 West 13th st., New York.

Patent Attorney. R. G. DuBois, 916 F. st., Washington, D. C. Service at reasonable rates. Send for pamphlet containing list of references.

Split pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

Machinists' supplies, brass goods, m't'rs supplies, polishing materials, all kinds wire, metals, etc., in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

Fine tools and supplies for machinists and other metalworkers. Get our prices before purchasing elsewhere. Montgomery & Co., 105 Fulton st., N. Y. City.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet illustrating pumping machinery and reports of duty trials.

Upright drills, improved, sizes 21", 23", 25", 28", 32", 36" swing; finely made and great capacity; write for cuts and prices. Currier & Snyder, Worcester, Mass.

W. H. Hoffman, consulting engineer, 108 Liberty st., room 3, N. Y. Mechanical engineering in all its branches; working drawings for the transmission of power by steam, water, air and electricity.

Parties requiring milling machine or screw machine work furnished, in large or small quantities, please write to the manufacturers, E. E. Garvin & Co., 139, 141, 143 Centre st., New York City.

Contract work of all kinds executed promptly and on reasonable terms. Parties wishing gray iron castings in large quantities can make money by corresponding with Rawson Mfg. Co., Hornellsville, N. Y.

A practical treatise on the steam engine, by Arthur Rigg, essays on the principles involved in design and construction of fixed engines; 312 pages, with 96 plates. 4to, cloth, $10.00. E. & F. N. Spon, 12 Cortlandt st., N. Y.

For the manufacture of
Patented articles in line of machine work;
Specialties in fine light machinery;
Accurate cam cutting;
Address Wardwell S. M. Co., Woonsocket, R. I.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the American Machinist. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Pub'g Co., 96 Fulton st., New York.

The series of articles by J. G. A. Meyer, on "Practical Drawing," now running in the American Machinist, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including June 30, 1888 issue, 53 articles have been so far published. Copies containing these articles, sent by mail to any part of this country or Canada, at 5 cents each. American Machinist Publishing Co., 96 Fulton st., New York.

"Modern Locomotive Construction," by J. G. A. Meyer. The above series of articles, now running in the American Machinist, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 68 articles have thus far appeared up to and including the July 7, 1888 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. American Machinist Publishing Co., 96 Fulton st., New York

MANUFACTURES

Matthew Rice will build a bobbin mill at Augusta, Ga.

J. C. Long will build a planing mill at Anniston, Ala.

The Trenton (Tenn.) Cotton Mills will build a ginnery.

R. J. Howard will build a planing mill at Pryorsburg, Ky.

Alexander Trexler will build a saw mill at Rockville, N. C.

A company has been chartered to build a woolen mill at Jackson, Tenn.

Lewis Jones is interested in building a rolling mill at Bessemer, Ala.

J. A. Barrett is interested in building a flour mill at New Middleton, Tenn.

The Pennsylvania R. R. Company will increase their shops at Altoona, Pa.

The Lynchburg (Va.) Cotton Mill and Improvement Company will build a mill.

A fire in the Tudor Iron Works, East St. Louis, Ill., resulted in serious damage.

The jewelry manufacturers of Attleboro, Mass., have all begun operations again.

S. S. King's sash, door and blind factory, Lexington, Ky., was destroyed by fire recently.

A saw mill and stave factory is to be built at Demopolis, Ala. L. M. Foulk is interested.

There is talk that the Southern Railroad Company will build shops at Washburne, Texas.

Ground has been broken for the new car shops of the Fitchburg railroad, at East Fitchburg, Mass.

The carpenter shop and machine shop of Warren Light, at Danbury, Conn., were recently destroyed by fire.

It is calculated that the increase in manufacture in Denver, Col., during the past year amounts to 30 per cent.

The Orange Belt Railroad Company contemplate changing the location of their shops from Oakland, to Sanford, Fla.

The Montgomery (Ala.) Electrical Street Railway Company has decided to rebuild its plant, recently destroyed by fire.

The Boston Duck Company, Bondsville, Mass., will build a new boiler house, and will put in several new boilers.

E. S. Newton & Co., East Saginaw, Mich., have issued a circular of their key way cutter. These machines are built in five sizes.

We learn that Fairbanks, Morse & Co., Chicago, Ill., are specially busy on orders for the Williams automatic engine, which they manufacture.

The machinery of Charles Draper & Son's plush jersey factory, Springfield, Mass., has been bought by Samuel Fitch & Sons, of Rockville, Conn., and will be moved to Rockville at once.

Williams, White & Co., Moline, Ill., send us a new illustrated catalogue. They manufacture machines for forging, shaping, welding, shearing, and punching iron for nearly all purposes.

Two buildings occupied by Laflin & Rand, manufacturers of powder, at Cresson, Pa., exploded recently with terrible force, killing two men and fatally injuring a third.

The city of Austin, Texas, is now lighted by electric light, the authorities having granted the requisite franchise to the electric light company in opposition to the gas company.

A lamp exploded in the repair shops of the New London Northern railroad at East New London, Conn., early the other morning, and the fire that resulted caused a loss of $50,000.

The Shultz Belting Company, St. Louis, Mo., have had a large increase in business during the past six months. They are at present engaged on belts for some of the most important mills in the country.

Parties from St. Paul, Minn., have bought a site 311 x 156 feet, in New Orleans, to build a large rice mill, and, it is said, will invest several hundred thousand dollars.

The Famous Mfg. Company, Quincy, Ill., whose works were recently destroyed by fire, have obtained temporary quarters, and are filling orders for baling presses and haying machinery, as usual.

Currier & Snyder, Worcester, Mass., send us a large folded circular, finely illustrated, of the upright drills made by them. Folded with the circular is a leaf containing a list of users of these drills.

The Benjamin Machine Company, of Chicago, Ill., has been incorporated, capital, $50,000, for the manufacture of wood working and other kinds of machinery; incorporators, R. B. Sample, H. M. Graham and R. W. Morrison.

There is talk of water-works at Fort Valley, Ga; Anita, Iowa; Miles City, Mont.; Mt. Clemens, Mich.; Fairport, N. Y.; Caribou, Maine; Hinesville, Ga.; Eustis, Fla.; Gladwin, Mich.; Elmira, N. Y.; Nevada, Mo.; Hughsville, Pa,

Frederick Sedgwick, of Cleveland, Ohio, is the inventor of a process for tempering springs by electricity. The process relates to tempering such as watch springs. We understand that a permanent plant has been equipped at Oak Park, Ill.

The new car shops of the New York and New England Railroad, at East Hartford, Conn., are nearly ready to be occupied. The plant includes 30 acres of land. There is talk of removing the general repair shops of the road to East Hartford.

The Sprague Electric Railway and Motor Company, of New York, has received an order from the U. S. Government for motors for use in the service, and an installation is to be made at once on board the U. S. steel cruiser "Chicago," of motors to be used.

Ryan & McDonald, Waterloo, N. Y., have filled an order for construction cars from Guayaquil, on the west coast of South America. They are to be used in railroad grading in Equador. This is said to be the first shipment of American construction cars into that part of the world.

Parties who have bonded the Carratunk Falls water-power at Solon, Maine, have made a proposition to the town that if the town will contribute to the building of a railway bridge for the benefit of the Somerset road, an extensive pulp mill will be erected there at an early day.

The Stanley tack factory, Belleville, Ill., resumed operations July 1, in their new building. New and improved machinery has been added to the plant, and the factory may be said to be fully equipped with every facility required in the manufacture of a complete line of tacks and fine nails.

A company has been formed in Gardiner, Maine, to manufacture flexible machine-turned shoes. "Enough stock has already been taken to make a certainty of the project," says the *Home Journal*. They will lease the furniture shop of G. W. Colburn for a term of years, and fit it up for the manufactory.

The Bangor, Me., Edge Tool Company have completed a pair of double engines of about 60 horse-power for a steamer built at Costigan, by Samuel Low & Son, to be used in towing logs on the Penobscot river. These engines have developed large power for propelling the steamer twelve miles an hour.

The Portland, Maine, Smelting and Reduction Works is a new works, working under patents granted to Professor Bartlett. In these works ores are treated with a view to ascertaining their full value, not only primarily, but in relation to by-products. Machinery is being made at the works for various mines in the country.

For quickness in raising money for business enterprises Hutchinson, Kansas, seems to outrank some of the large cities. They called a meeting out there for such a purpose, and, after the hall was filled, locked the door. A local paper tells that work then began, and in just one hour and fifteen minutes the sum of $224,000 was subscribed.

The largest saw mill plant in the South is now being erected at Brewton, Ala. The engine and much of the mill machinery is in position. The capacity of the mill will be 200,000 feet of lumber per day. It will give employment to over 250 men. This large mill is the property of the Peters Lumber Company, of Manitee, Mich., and is situated on the line of the Louisville railroad. It will go into operation August 1.

Franklin Van Winkle, M. E., Consulting Engineer, 91 Liberty street, New York, has issued a neat card arranged for hanging. On one side of this card is a cut and brief description of the Van Winkle power meter, or rotary transmitting dynamometer; on the other side is a table showing compound discounts reduced to simple nets and discounts. This table would, we should think, be found very convenient in any business office.

A special town meeting at Waldoboro, Maine, unanimously accepted the proposition of Henry & Daniels, shoe manufacturers of Boston, to erect a building and provide it with shafting, pulleys, elevators and sprinklers, in consideration of the removal of their eastern business to that town Twenty thousand dollars was appropriated for the purpose, and Thursday evening houses were illuminated, bells rung, 50 guns fired and a street parade made, in celebration of the event.

A fire at Avon, Mass., destroyed the boot and shoe factory of G. F. & L. G. Littlefield, and before it was under control it had made a clean sweep of all before it, and laid almost the entire business portion of the village in ruins. The loss on Littlefield's factory is $60,000, insurance $30,000. Two hundred and fifty hands were thrown out of employment. The firm had been doing a large business. Among the other buildings which were burned is Charles Smith's tannery; loss, $3,000.

The La Belle Nail Factory and Plate Mill at Wheeling, W. Va., is shut down to make changes and improvements. The present plate mill will be removed, and in its place a large three-high plate mill will be erected. With this new mill a nail plate any width up to three feet can be rolled. It can be used equally well to run plate from o'd steel rails or steel slabs. Twenty-six small nail machines will be placed in the tack factory now being built. Pickled plate will be used exclusively, and the nails made will be either polished or blued, as the trade desire.

Massachusetts parties have purchased the Spofford water power at Bucksport, Maine, and have commenced the erection of a mill on Main street, in the village. The mill is to be 70 x 23 feet, and is being erected under the charge of W. R. Close, an experienced millwright. Staves, shingles, box-boards and heading will be manufactured, and the mill is expected to be in operation during the fall. The source of water supply is Great Pond, and the purchase includes eight falls, six of them within a distance of 125 rods. The power from the several falls is all to be concentrated at the lower privilege by the use of wire cables.

The Tennessee Coal, Iron and Railway Company have in blast three stacks at South Pittsburgh, one at Cowan, Tenn., two at Birmingham, Ala., and two at Ensley City, Ala. By the 31st of next January it is expected to have two more going at Ensley City, making ten in all. Then the total output of the company's plants will be about 8,000 tons a week, or in round figures say, 400,000 tons a year, more coke iron than the whole South had capacity to make five years ago. The company's two new stacks at Ensley City are making about 300 tons of good iron daily. Work on the two that are incomplete is being pushed, with the expectation that they will be ready for the blast, one in October next, the other in January, '89.—*Tradesmen.*

C. A. Peavey and J. H. Peavey, who comprise the Bangor [Maine] Edge Tool Company, are both practical machinists. Sixteen years ago they commenced in a small way the manufacture of edge tools at Morse's Mills, this city. Later they removed to Washington street and about ten years since established themselves in their present commodious quarters on Exchange street. From small proportions their business has steadily expanded, until they now manufacture yearly from 12,000 to 15,000 cant dogs and from 6,000 to 7,000 axes, besides doing a large amount of general machine work. Where originally the work was done almost entirely by the two members of the firm they now keep busy from twenty-five to thirty hands in winter and from fifteen to eighteen in summer.—*Industrial Journal.*

According to the New York *Times*, manufacturers and dealers in cotton bagging have formed a combination for the purpose of controlling the market and putting up prices. Although the association is not exactly in the nature of a trust, it will in all probability have much the same effect that the sugar combine has among refiners. There are in the United States about thirteen large establishments where bagging is made for supplying planters and packers with covering for bale cotton. At the offices of the New England and Brooklyn manufacturers in this city it was stated that manufacturers and dealers were refusing to sell large amounts of bagging till they can regulate the prices to suit themselves. The attitude of the combine has caused a great deal of uneasiness among cotton men in the South, and the latter are trying to devise some method to arrest the advances in prices and break up the corner in the market. Consumers who wish to put in a supply against the approaching business season may be compelled to wait till late in August before they can get their order filled.

The Davis Carbon Manufacturing Company, St. Louis, Mo., have ordered two more presses, to be built from designs and specifications furnished by President Davis, with a view of increasing their output, exclusive of minor specialties, from 20,000 carbon points a day to 35,000. It is interesting to note in this connection that this interprise is strictly co-operative, from "top to bottom." Its conceiver and leading spirit, Mr. J. H. Davis, says there is not a man in the employ of the company in any capacity that isn't a stockholder, and from what could be further learned, it appears that the utmost harmony and good will prevails among all concerned. Mr. Davis is modestly hopeful of the success of his venture, which, he thinks, come what may, embodies the correct principle of creating a perfect union of interest between employer and employed. Aside from being an original thinker on economic and industrial questions, Mr. Davis stands well as an inventor and practical manager of machinery, all though he has never taken the trouble to ask for letters patent. Indeed, one of his reasons for making every employe a stockholder is to preserve for his company's exclusive use the secrets of processes of manufacture, of more or less value.—*Age of Steel.*

Machinists' Supplies and Iron.

New York, July 19, 1888.

Iron—American Pig—We quote Standard Lehigh and North River brands, $17.50 to $18.50 for No. 1 X Foundry, $16.50 to $17.50 for No. 2, and $15 to $16 for Grey Forge. Outside brands are offered at 50 to 75 cents less than these prices.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Men to examine S. S. planes; see p 11.

Wanted—Position by a foreman pattern maker; best reference. Box 6, Am. Machinist.

A mech'l draftsman, graduate from a polytechnic school, wants position. Address W. K., Am. Machinist.

Situation wanted by first-class machinist and tool maker; one who understands taking charge of help. Address Box 4, American Machinist.

Experienced mech'l draftsman (shop tools, special machinery,) is open to engagement from Sept. 1st next; best of ref. Address Box 1, Am. Machinist.

Wanted—By a thoroughly competent machinist, a position as foreman; understands laying out work and the handling of men to best advantage. Address Push, American Machinist.

Wanted—Situation as foreman blacksmith, by a man of long experience on engine work; would take shop by contract; held similar situation 12 years; good references. Box 5, Am. Machinist.

Wanted—A practical foundry foreman, by a car manufacturing company; to satisfactory man fair wages and steady employment will be assured. Address, giving references and stating experience and salary desired, M. D., Am. Machinist.

Lad of 19, can read drawings, and having a thorough knowledge of universal milling machines, also of planers, lathes and drills, desires work in a first-class machine shop; best of references. Address Intelligence, American Machinist.

Wanted—Situation to represent mfrs. in New York, by a gentleman with long experience in machinery, engines, and supplies, and would travel part of the time; can give best of references as to ability, integrity, etc. Address A. L. B., Am. Machinist.

Wanted—A thoroughly competent salesman well posted on iron-working and wood-working machinery, steam engines and boilers, steam pumps, etc.; good salary and permanent position for right man. Address John R. Wilberton, P. O. Box 16, Portland, Oregon.

Wanted—For good permanent position, a good man thoroughly experienced in the different branches of fine machine work and tool making; one having knowledge of drafting preferred. Address, stating age, etc., Charles Hutchinson, Detroit Electrical Works, Detroit, Mich.

Live man wants New England agency for first-class manufacturing company; commercial experience; fair bookkeeper; understands accounts and correspondence; can make contracts; sold goods 12 years; can attend to all matters of a branch house; understands machinery and its details; has worked as draftsman and machinist; can fill position worth $2,500 a year. B. M. E., Am. Machinist.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Crescent steel tube scrapers are unquestionably the best. Crescent Mfg. Co., Cleveland, Ohio.

Crescent boiler tube cutter, for setting new and removing old tubes. Crescent Mfg. Co., Cleveland, O.

Wanted—Special machinery to build; correspondence solicited. F. D. Büttricks, New Haven, Conn.

D. J. Kelsey, M. E., designs machinery and iron structures; pat. drawings. 31 Ins. Bld., New Haven, Ct.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Wanted—Parties having machinery specialties to build, to correspond with. Box 75, Am. Machinist.

Correspondence solicited with parties having machine or foundry specialties to build. Honesdale Iron Works, Honesdale, Pa.

I will visit and give instruction in tempering taps, reamers, milling cutters, dies, gauges, etc., etc.; correspondence solicited. C. B. H., Box 513, Oil City, Pa

Wanted—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert streets, Cincinnati, Ohio.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

For Sale—My patent flue cleaner, or would like to get it man'f'd on royalty; see cut in this paper, June 9, 1888. For further information address E. D. Weston, Jackson, Mich.

For sale or manufacture on royalty, flue welder; welds in fire any size or length; can be manufactured cheap; illustrated in *Locomotive Engineer* for July. Address John N. Buchanan, Batavia, N. Y.

Wanted—Slide lathe 16" or 18" swing and 4' to 5' bed; Brass Monitor Lathe, medium size; Shaping Machine 12' stroke, improved style; Small Drilling Machine for post. Address "Compressor," Am. Machinist.

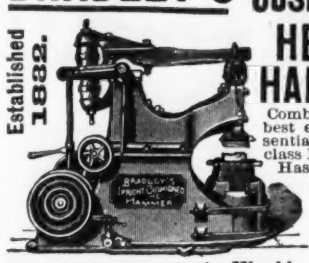
August C. Christensen, M. Am. S. M. E., 24 State st. (Battery), N. Y.; 463 Henry st., Brooklyn. Working drawings and superintending the building of machinery; steam, pumping and gas engines indicated.

E. W. Naylor, 149 B'way, N. Y., consulting eng'r. Designs for iron & steel work, mch'y, hyd. presses, cranes, etc.; R'y traffic & freight plant, warehouse & dock cranes & hoists; 20 y'rs' exp. best Eng. firms.

For Sale—Machine shop, foundry and forges, to settle an estate; business established 40 years and never shut down for want of business; running at present 16 men entirely on job work, which can be doubled in one year by practical party; price reasonable and terms easy. Address F. R. Page, Olean, N. Y.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

Established 1832.



Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other Hammer in the World.

Bradley's HEATING FORGES

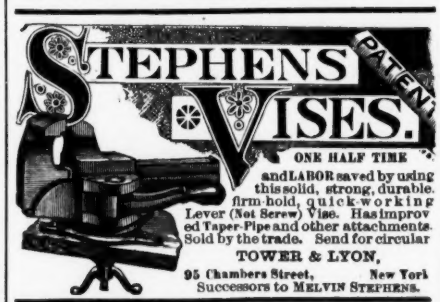
Established 1832

With a manufacturing experience of over half a century, we recommend these machines to be the best, simplest, most durable and combining all the essential elements.

For hard coal or coke. Indispensable in all shops to keep Bradley's Cushioned Hammers and men fully employed and reduces cost of production.

BRADLEY & CO., Syracuse, N. Y.

STEPHENS PATENT VISES.



ONE HALF TIME and LABOR saved by using this solid, strong, durable, firm-hold, quick-working Lever (Not Screw) Vise. Has improved Taper-Pipe and other attachments. Sold by the trade. Send for circular

TOWER & LYON,
95 Chambers Street, New York
Successors to Melvin Stephens.

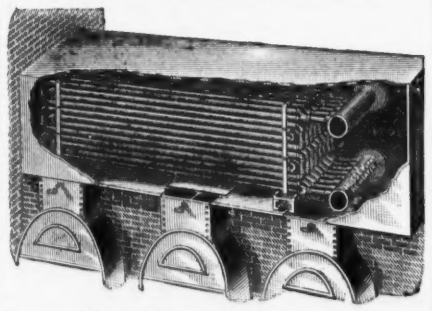
Iron Foundry of T. Shriver & Co.,
333 E. 56th St., N. Y. City.

Nice Castings, Smooth and True to Patterns, of very best brands of Pig Iron.
CASTINGS IN QUANTITY AT FAVORABLE PRICES.

UNIVERSAL RADIAL RADIAL DRILLING MACHINES

THREE DESIGNS. SIX SIZES
EMBODY ALL DESIRABLE FEATURES
PRICES $450 00 & UPWARD
UNIVERSAL RADIAL DRILL CO
CINCINNATI, O. U.S.A.

THE HUSSEY RE-HEATER
RE-HEATS EXHAUST STEAM.



Super-Heats Live Steam,
Heats Air or Water
WITHOUT COST.
The Hussey Re-Heater and Steam Plant,
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S. D. Brewer, Gen'l Manager. 15 Cortlandt St, N. Y.

93 Liberty St., NEW YORK. | 113 Federal St., BOSTON.

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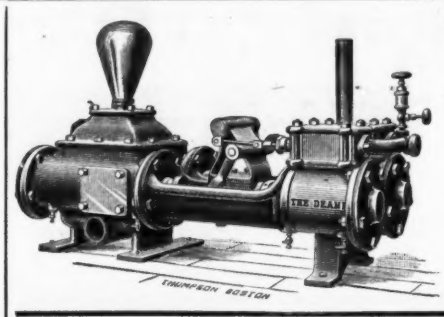

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HOLYOKE, MASS.,
New York, Boston, Chicago, Philadelphia, St. Louis,
Manufacturers of
STEAM and POWER
PUMPS
FOR ALL PURPOSES.
SEND FOR CATALOGUE.

SECOND-HAND LATHES FOR SALE.

14 in. x 6 ft., Blaisdel.	14 in. x 6 ft., Star Tool Co.
16 " x 6 " Ames Manufacturing Co.	16 " x 10 " Bridgeport.
18 " x 8 " Star Tool Co.	22 " x 8 " Star Tool Co.

1 Davis Key Seater, *new*, with full set Cutters, ⅛ to 1 in.

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BEST CAST STEEL.

For MACHINISTS' TOOLS and DIES DOING CONTINUOUS HARD WORK.
MILLER, METCALF & PARKIN, CRESCENT STEEL WORKS,
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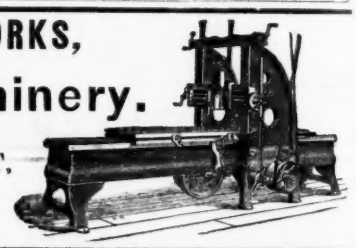
Sebastian, May & Co.'s Improved Screw Cutting
FOOT AND POWER **LATHES**

Dr'll Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.
167 West Second Street, CINCINNATI, O.
OUR SPECIALTIES, 8, 12, 14 and 18 inch Lathes.

GUILD & GARRISON, Kent Ave. and South 10th St., Brooklyn, N.Y.
Builders of Steam Pumps, Vacuum Pumps, Vacuum Apparatus, Filter-press Pumps, Air Compressors, etc.

FITCHBURG MACHINE WORKS,
Manufacturers of
Metal-Working Machinery.
OFFICE AND WORKS
NOS. 13 to 21 MAIN STREET,
FITCHBURG, MASS.



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BALL AUTOMATIC CUT-OFF ENGINES.

The characteristics of these Engines are Beauty of Design, Superior Finish, Limited feet in Space required, Economy of Fuel, Perfection of Regulation.

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"Star" Foot Lathe Swings 9x25 in. | Screw Cutting Automatic Cross Feed, etc.
LATHE
Scroll Saws, Circular Saws, Lathes Mortisers. | Catalogue Free of all our Machinery.

Seneca Falls Mfg. Co. 687 Water St., Seneca Falls, N.Y

TANITE
EMERY WHEELS and GRINDING MACHINES
FOR SAW MILLS, FOUNDRIES AND MACHINE SHOPS
For Circulars address
THE TANITE COMPANY, STROUDSBURG, MONROE CO., PA.
Or H. A. ROGERS, 19 John St., N. Y.

THE CAPITOL TOOL CO.,
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MAKERS OF
SEYMOUR'S PATENT
Lathe and Planer Tool.

Without exception the best and cheapest Tool Made.

No forged or finished cutters. Will give perfect satisfaction. Ask your dealers, or send $2.45 and receive one with 4 cutters by return mail.

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MANUFACTURERS OF

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Patent Friction Pulleys.
Water St., Corner Ledge,
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Dodge Independence
Wood Split Pulleys.
Lighter than Iron.
Greater traction than Iron.

Bushing system allows each pulley to be fitted to 22 sizes of shafts.

COOKE & CO., Sales Agents,
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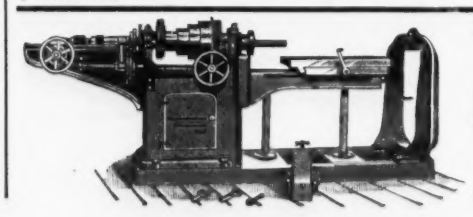
Shafting, Hangers, Engines, Boilers, Etc.
Write for prices, mentioning this paper.



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OF SUPERIOR QUALITY,
FOR USE IN
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FILE CARD.

Files and Rasps

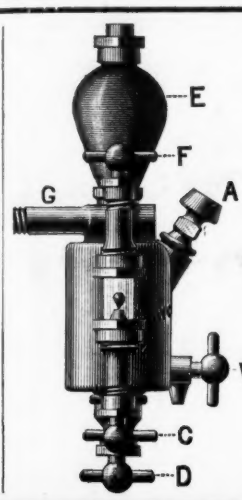
FILE BRUSH.

Having the Increment Cut.

The illustrations herewith presented exhibit more convenient and durable forms of **File Cleaners** than are usually found, the majority of those in use being rudely devised and troublesome, and we believe, for this reason, those of our manufacture will find a ready sale. Machinists and others who have not already given them a trial, will find it to their advantage to order the **File Card** and **File Brush** at once.

Manufactory and Office,

PROVIDENCE, R. I., U. S. A.



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FOR STATIONARY ENGINES AND PUMPS OF ALL KINDS. LUBRICATORS FOR SINGLE OR DOUBLE CONNECTION.

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Nos.	1	2	3
Price	$10.00	$12.00	$15.00
Capacity	⅛ pt.	½ pt.	¾ pt.

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Send for Catalogue. **SOLE MANUFACTURERS.**

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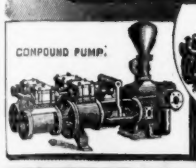
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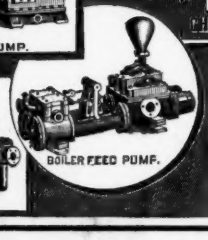
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Root's Force Blast Rotary Blower.

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FOUNDRIES, SMITH SHOPS, PNEUMATIC TUBES, VENTILATION, ETC.

SLOW SPEED, POSITIVE BLAST, PERFECTLY BALANCED.

Best Mechanical Construction.

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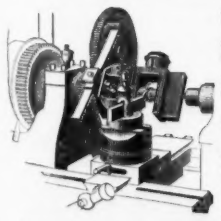
In Writing, Please Mention This Paper.

COATES' PATENT LATHE ATTACHMENT FOR TURNING CROSS-HEAD PINS.



This machine is new and has been thoroughly tested.

Actual tests show a saving of over $10.00 per day over old methods.

Can attach machine to or remove it from any ordinary engine lathe in five minutes.

An ordinary shop, in building engines, will save price of machine in 3 months' time.

An ordinary apprentice can operate machine perfectly well, and turn out first-class work.

Above features guaranteed.

Send for circular and price list.

SALESMEN WANTED. SEND FOR CONTRACT AND BLANK ORDERS.

BAY STATE IRON WORKS,
Licensees and Manufacturers,
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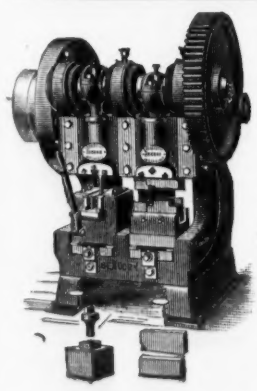

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COMBINING
PRESS, SHEARS AND PUNCH.

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Sole Manufacturers.
Also manufacturers of
HARD COAL HEATING FORGES.
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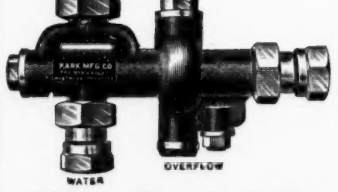

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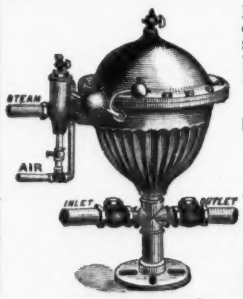
The Park Injector,

EJECTORS AND JET APPARATUS.

CURTIS RETURN STEAM TRAP



For returning steam, condensed under pressure, automatically into the boiler, under high or low pressure.

Manufactured by

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General Agencies:
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ONE MAN SUFFICIENT.

Quick lifting, quick lowering. Without touching hand rope, the load may be quickly lowered. Can be used for long or short lifts; will hold a load at any point.

ENERGY MFG. CO.,
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Manufacturers of Set, Cap and Machine Screws, Studs, etc.

W. C. YOUNG & CO., Worcester, Mass. Manufacturers of

Engine Lathes, Hand Lathes,
Foot Power Lathes, Slide Rests, Etc.

REDUCED PRICES OF LeCOUNT'S STRAIGHT TAIL DOG.

To be driven from a Stud in the Face Plate.

No.	INCH.	PRICE.	No.	INCH.	PRICE
1	¾	$0.60	10	2¼	$1.35
2	⅞	.70	11	2½	1 45
3	1	.70	12	3	1.60
4	1⅛	.80	13	3½	1.80
5	1¼	.80	14	4	2.10
6	1⅜	.95	15	4½	2.75
7	1½	.95	16	5	3.25
8	1¾	1.10	17	5½	4.00
9	2	1 20	18	6	5 00
1 Set to 2 in.		7.80	Full Set		31.10

C. W. LeCOUNT, South Norwalk, Conn.

DEAN BROS.' STEAM PUMP WORKS.

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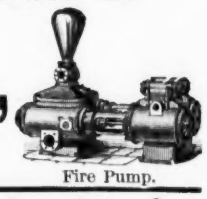
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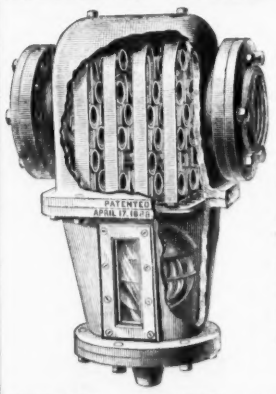

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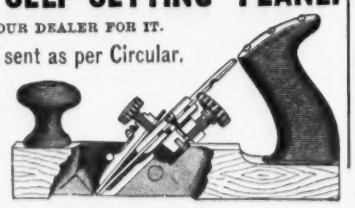

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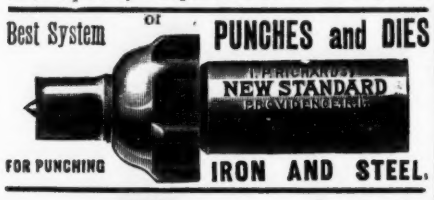

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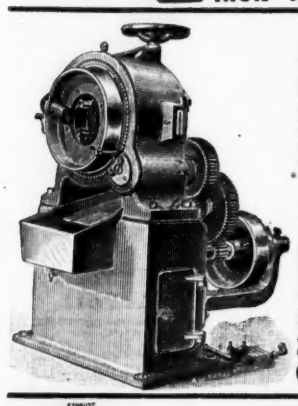

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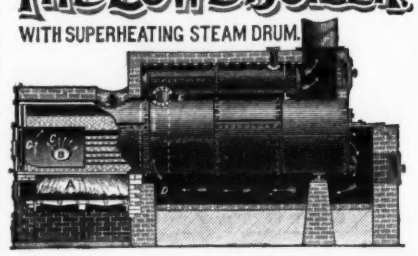

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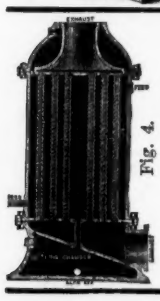

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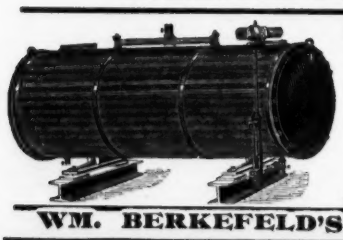

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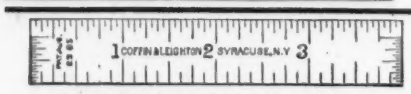

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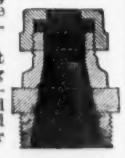

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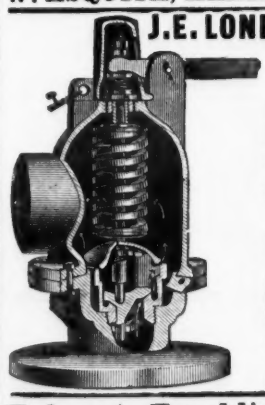

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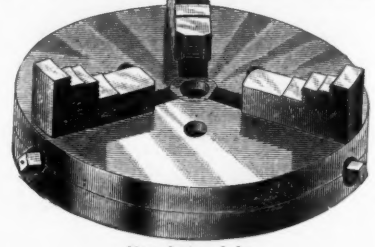

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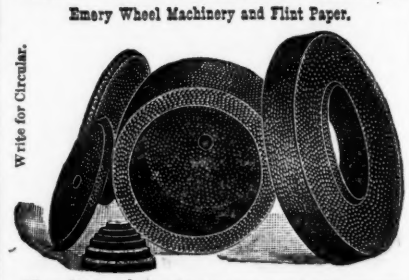

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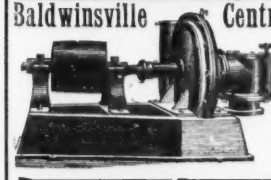

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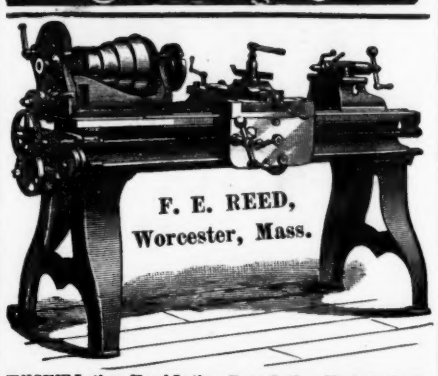

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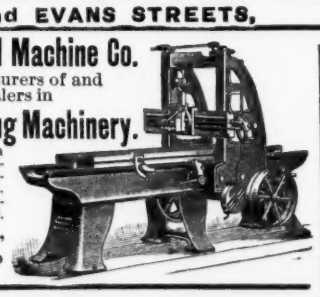

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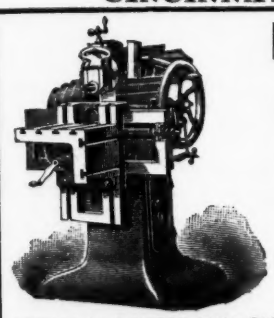

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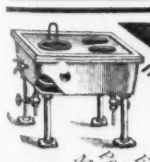

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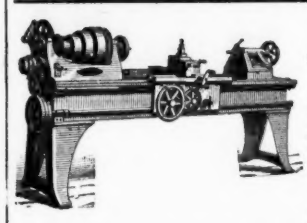

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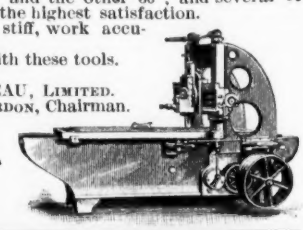

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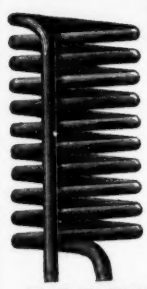

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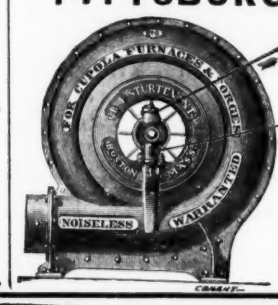

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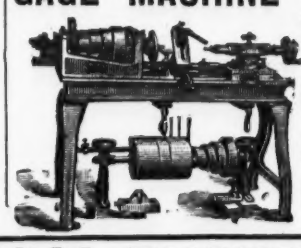

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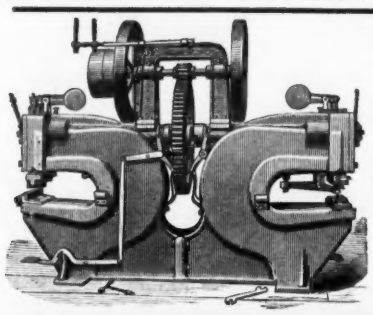

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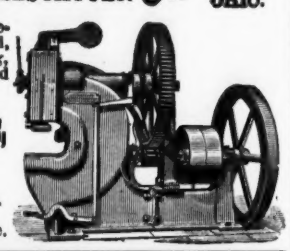

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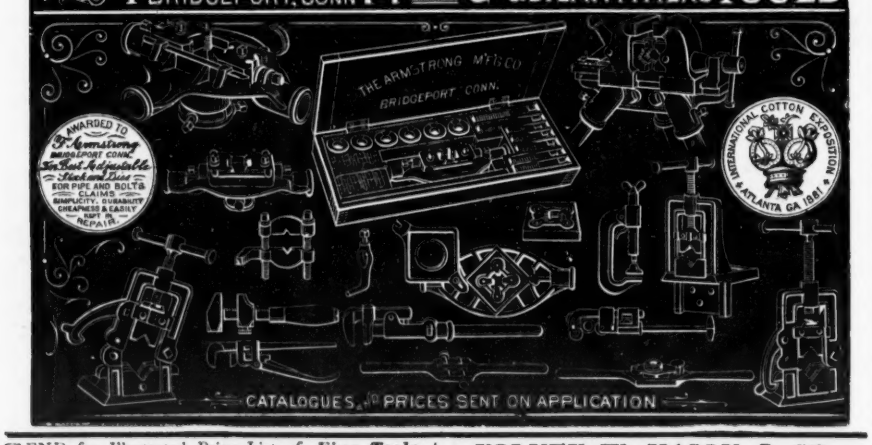

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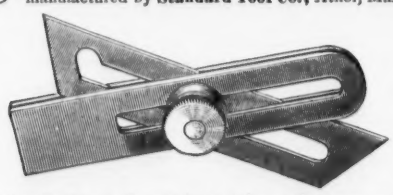

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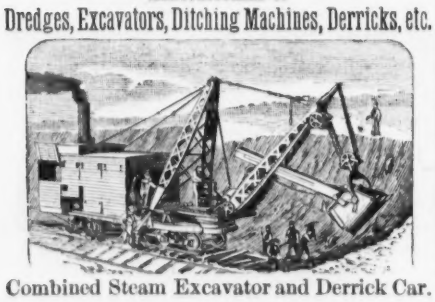

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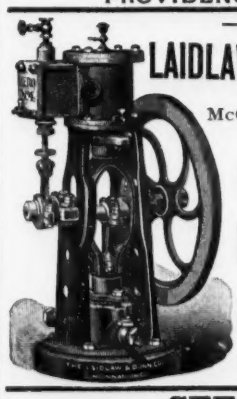

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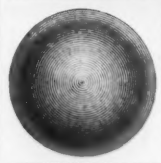

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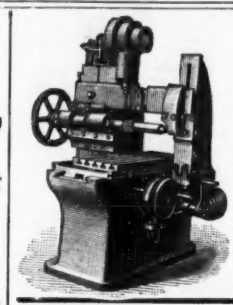

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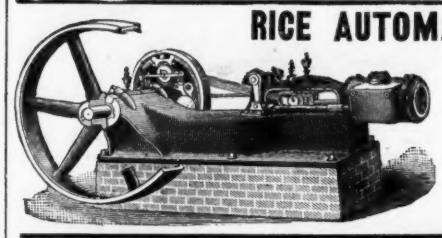

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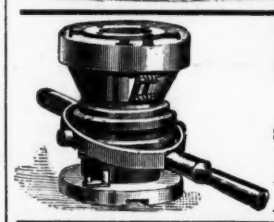

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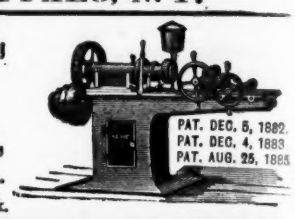

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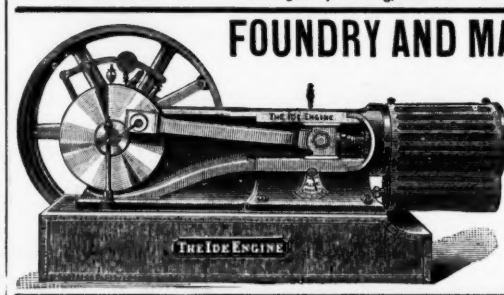

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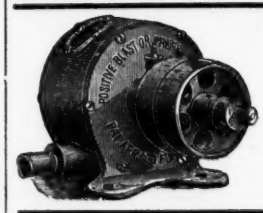

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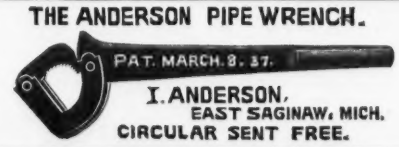

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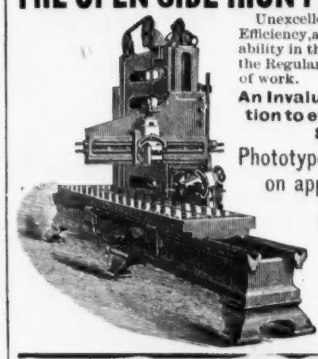

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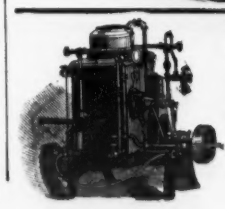

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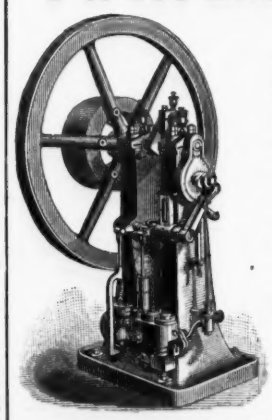

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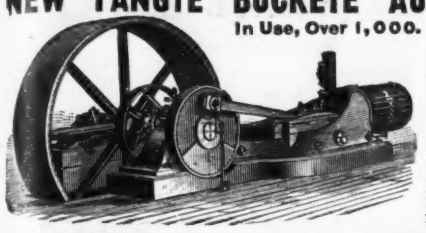

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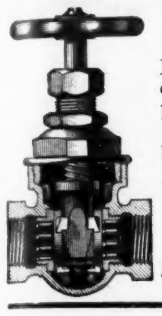

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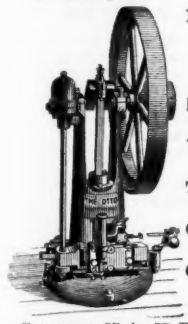

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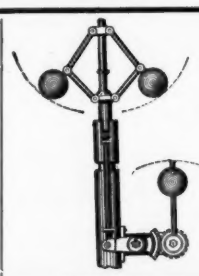

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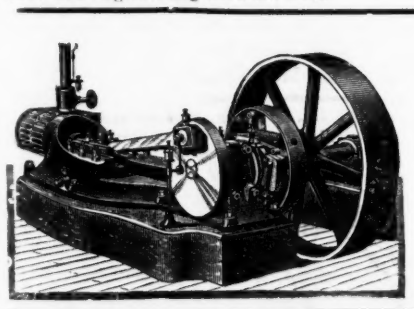

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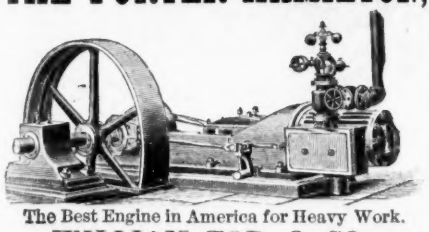

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14 in. x 7 ft.	"	Bogart,	"
14 in. x 6 ft	" Gap Bed,	S. M. & Co.,	"
15 in. x 6 and 8 ft.	"	Porter,	"
16 in x 6 ft.	"	Ames,	A 1.
16 in x 6 and 8 ft.	"	Blaisdell,	new.
16-20 in. x 6-8-10 & 12 ft.		Bridgeport,	"
18 in. x 8-10-12 ft.	"	Different Makes,	"
20 in. x 8-10-14 ft.	"	Different Makes,	"
20 in. any length Bed	"	Bridgeport,	"
22 in. x 12 ft.	"	Niles,	heavy.
23 in. x 8-10-12 & 14 1-2	"	Bridgeport,	new.
26 in x 12 ft.	"	Wright,	new.
28 in. x 16 ft.	"	Fifield,	"
36 in. x 14 ft.	"	Fifield,	"
20 in. Drill		Davis,	"
20-22-25-28 inch Drills		Blaisdell,	"
20-25-28 32 inch	"	C. & S.	"
5 ft. Arm Universal Radial Drill,			"
No. 1 and 3 Universal Miller, Brown & Sharpe,			"
No. 1-2 and 6 Plain	"	"	"
No. 1 Universal Grinder,	"	"	"

Cold Rolled Shafting in Stock. Send for list. Write for what is wanted.

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We are now placing on the market 17", 24", and 27" Engine Lathes, same design and construction as our celebrated 19" and 21" Lathes.

We shall produce them in large lots, in order that we may be able to offer them at the popular prices that induced the unprecedented sale of our 19" and 21" Lathes.

Weight of 24" with 10 ft. bed, 5200 lbs.

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We furnish, without extra charge, *Taper Attachment, Compound Rest, Automatic Stop for Carriage, Pulley Rest, Etc.*, in addition to regular attachments.

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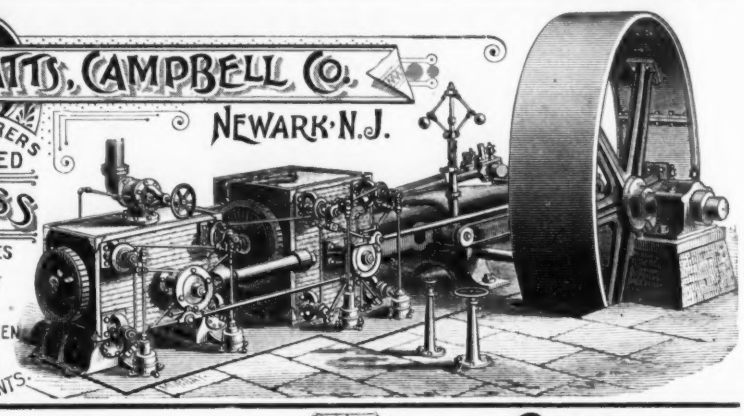

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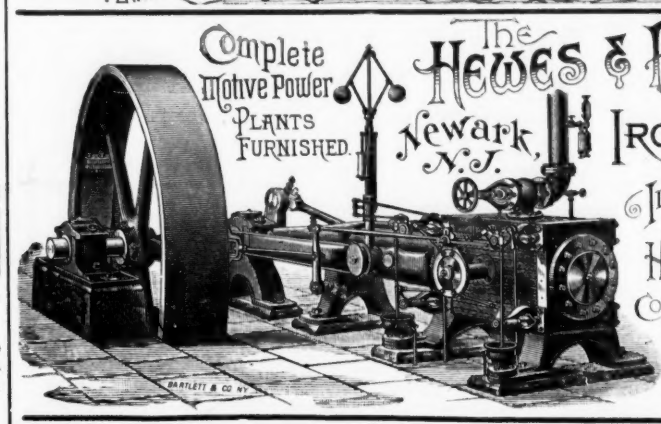

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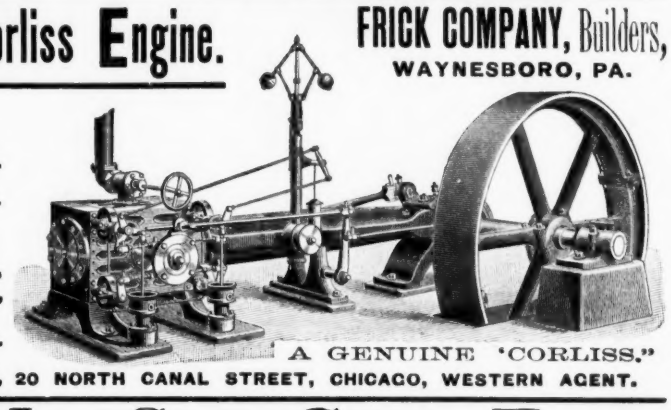

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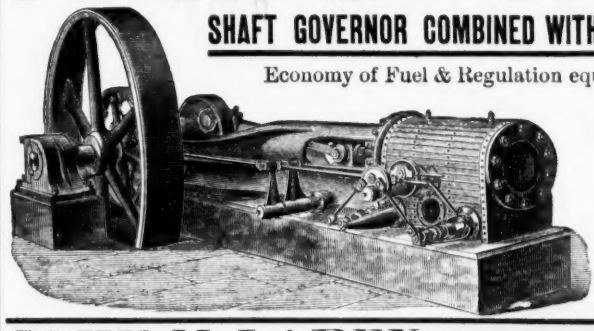

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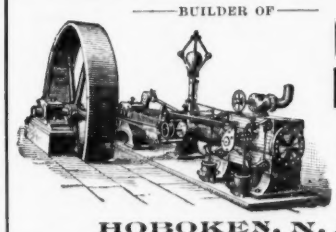

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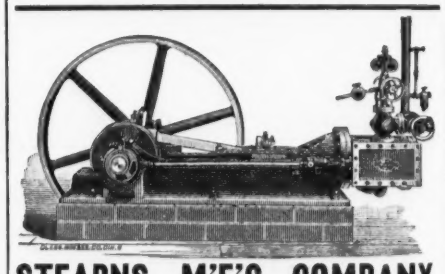

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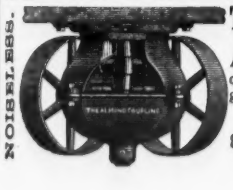

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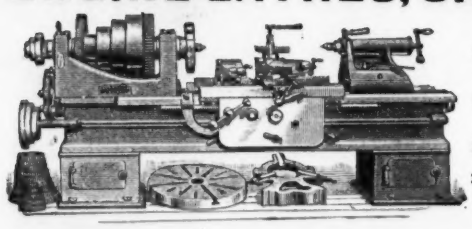

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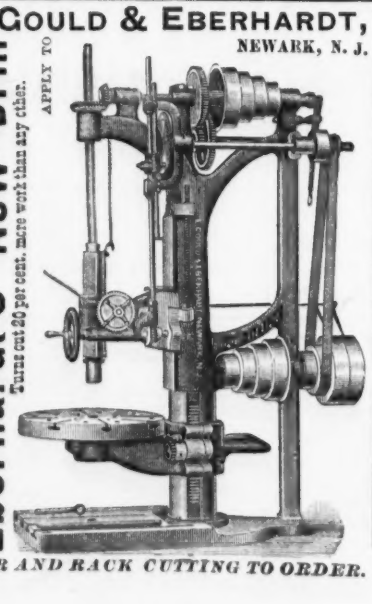

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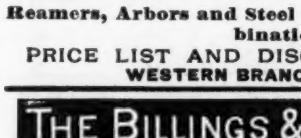

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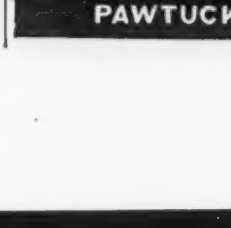

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